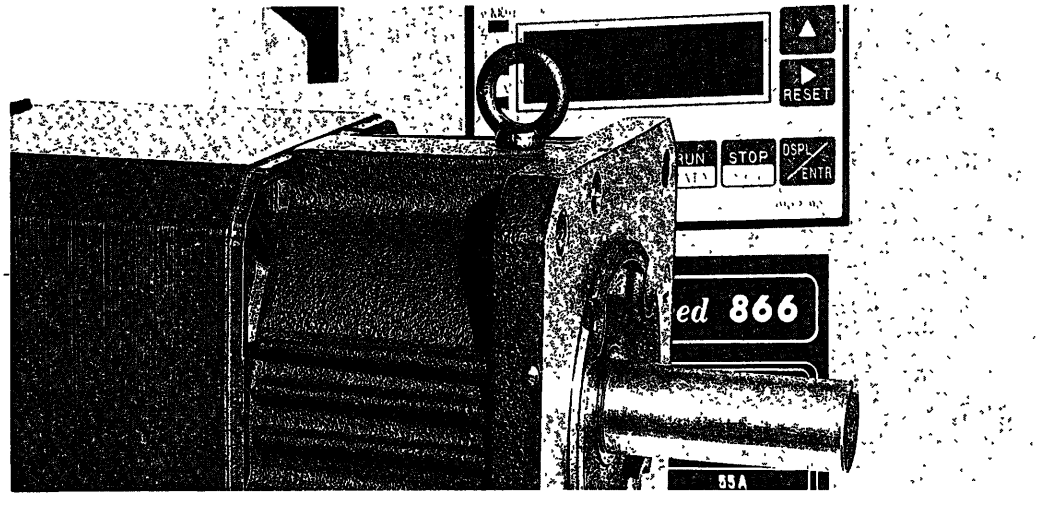
# Varispeed-866 SERIES

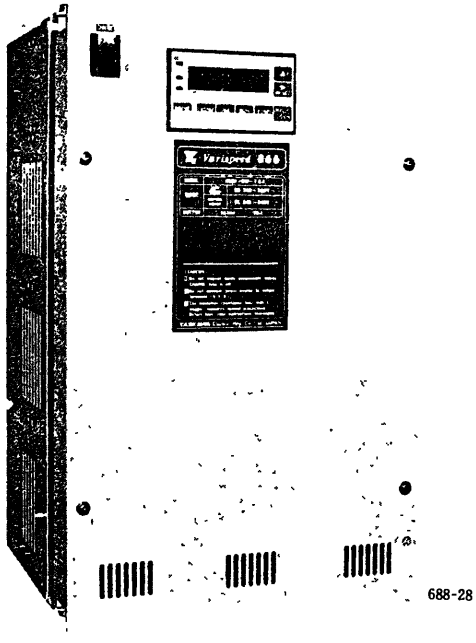
## LARGE-CAPACITY/HIGH-OUTPUT AC SERVO DRIVE

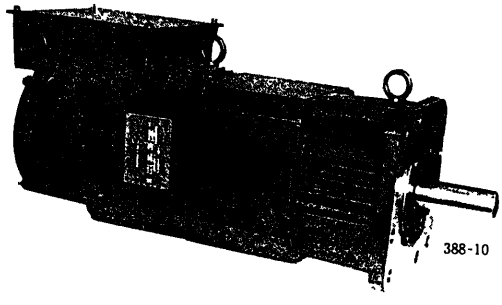
VECTOR-& DIGITAL-CONTROLLED IM
DRIVE 3 TO 50 HP (2.2 TO 37 kW)




YASKAWA

Yaskawa now introduces a new member, VS-866, of our AC servo drives.
The VS-866 consists mainly of an IM (squirrel-cage induction motor) and its servo driver. This wide range of motors can be driven in any one of three types of controls: speed, positioning, and high precision torque controls to meet your every need for a drive system. Especially, these controls solve a lot of user requirements: wide range of speed control, high power rate for quicker response, and lower torque ripple.



# CONTENTS

# INDEX

# 1 RATINGS AND SPECIFICATIONS

## 1.1 RATINGS AND SPECIFICATIONS OF SERVOMOTOR

• Servomotor General Specifications

Time Rating: 50% ED

Insulation: Class F

Dieletric Voltage: 1500 VAC for one minute

Insulation Resistance: 10 MΩ or more by 500 VDC

Ambient Temperature: 0 to 40℃

Ambient Humidity: 20 to 80% (non-condensing)

Vibration: V10 max.

Noise: 1500 rpm series, 22 kW or less ···· 75 dB(A) max.

30 kW or more ···· 78 dB(A) max.

750 rpm series, 11 kW or less ···· 75 dB(A) max.

15 kW or more ···· 78 dB(A) max.

Mounting: Flange-mounted (Foot-mounted available)

Finish in Munsel Notation: N1.5

• Detector Specifications

Standard:

Incremental encoder (6000 pulses/rev)

Option:

Absolute encoder (8192 pulses/rev)

(1) 1500 r/min series

Table 1.1 Ratings and Specifications of 1500 r/min Series Servo Motor

| Type UAAC□□□-□□□□ | | KA-03A □□#2 | KA-04A □□#2 | KA-06A □□#2 | KA-08A □□#2 | KA-11A □□#2 | KA-15A □□#2 | KA-22A □□#2 | KA-30A □□#2 | KA-37A □□#2 |
|---|---|---|---|---|---|---|---|---|---|---|
| Rated Output (50% ED) | kW<br>HP | 2.2<br>3 | 3.7<br>5 | 5.5<br>7.5 | 7.5<br>10 | 11<br>15 | 15<br>20 | 22<br>30 | 30<br>40 | 37<br>50 |
| Continuous Output | kW<br>HP | 1.5<br>2 | 2.2<br>3 | 3.7<br>5 | 5.5<br>7.5 | 7.5<br>10 | 10<br>13.4 | 13<br>17.4 | 22<br>30 | 26<br>35 |
| Rated Speed | r/min | 1500 | | | | | | | | |
| Max Speed | r/m. | 2000 (Constant power for 1500 to 2000 r/min) | | | | | | | | |
| Rated Torque (50% ED) | N.m<br>lb.in | 14.0<br>124 | 23.5<br>208 | 35.0<br>310 | 47.7<br>422 | 70.0<br>620 | 95.4<br>844 | 140<br>1239 | 191<br>1690 | 235<br>2115 |
| Continuous Torque | N.m<br>lb.in | 9.51<br>84.2 | 14.0<br>124 | 23.5<br>208 | 35.0<br>310 | 47.7<br>422 | 63.6<br>563 | 82.7<br>732 | 140<br>1239 | 166<br>1469 |
| Peak Torque | % | 200 | | | | | | | | |
| Rated Current | A | 20 | 27 | 39 | 55 | 76 | 101 | 139 | 188 | 224 |
| Current at 200% Torque | A | 38 | 52 | 74 | 111 | 149 | 195 | 277 | 376 | 445 |
| Power Rate | kW/s<br>HP/s | 75.5<br>101 | 112<br>150 | 170<br>228 | 228<br>306 | 312<br>418 | 385<br>516 | 429<br>575 | 603<br>808 | 694<br>930 |
| Unit Accel Time | ms | 30.0 | 33.0 | 32.3 | 32.9 | 35.1 | 38.7 | 51.2 | 49.5 | 53.2 |
| Moment Inertia of Motor J* | kg·cm²x10⁻³<br>lb·in·S²x10⁻³ | 28.8<br>23.7 | 49.3<br>43.7 | 72.0<br>63.8 | 100<br>88.5 | 157<br>139 | 236<br>209 | 458<br>405 | 605<br>536 | 798<br>707 |
| Enclosure | | Totally-enclosed, externally fan-cooled | | | | | | | Dripproof protected externally fan-cooled | |

# □ in type designation is determined by output (pulses/rev) of optical encoder as follows:
- Standard: A (incremental 6000 pulses/rev)
- Optional: S (absolute 8192 pulses/rev)

(2) 750 r/min series

Table 1.2 Ratings and Specifications of 750 r/min Series Servo Motor

| Type UAAC[ ][ ]-[ ][ ][ ][ ] | | KL-03A[ ]*2 | KL-04A[ ]*2 | KL-06A[ ]*2 | KL-08A[ ]*2 | KL-11A[ ]*2 | LL-15A[ ]*2 | LL-19A[ ]*2 |
|---|---|---|---|---|---|---|---|---|
| Rated Output (50% ED) | kW<br>HP | 2.2<br>3 | 3.7<br>5 | 5.5<br>7.5 | 7.5<br>10 | 11<br>15 | 15<br>20 | 18.5<br>25 |
| Continuous Output | kW<br>HP | 1.5<br>2 | 2.2<br>3 | 3.7<br>5 | 5.5<br>7.5 | 7.5<br>10 | 11<br>15 | 15<br>20 |
| Rated Speed | r/min | 750 | | | | | | |
| Max Speed | r/min | 1000 (Constant power for 750 to 1000 r/min) | | | | | | |
| Rated Torque (50% ED) | N.m<br>lb.in | 28.0<br>248 | 47.0<br>416 | 70.0<br>620 | 95.4<br>844 | 140<br>1239 | 191<br>1690 | 235<br>2115 |
| Continuous Torque | N.m<br>lb.in | 19.1<br>169 | 28.0<br>248 | 47.1<br>417 | 70.0<br>620 | 95.4<br>844 | 140<br>1239 | 191<br>1690 |
| Peak Torque | % | 200 | | | | | | |
| Rated Current | A | 19 | 32 | 44 | 58 | 80 | 108 | 129 |
| Current at 200% Torque | A | 34 | 63 | 86 | 112 | 161 | 217 | 259 |
| Power Rate | kW/s<br>HP/s | 109<br>146 | 222<br>297 | 312<br>418 | 385<br>516 | 429<br>575 | 603<br>808 | 694<br>930 |
| Unit Accel Time | ms | 20.2 | 16.7 | 17.6 | 19.5 | 25.5 | 24.7 | 26.6 |
| Moment Inertia of Motor $J^{*}$ | kg·cm²x10⁻³<br>lb·in·S²x10⁻³ | 72.0<br>63.8 | 100<br>88.5 | 157<br>139 | 236<br>209 | 458<br>405 | 605<br>536 | 798<br>707 |
| Enclosure | | Totally-enclosed, externally fan-cooled | | | | | Dripproof protected externally fan-cooled | |

* [ ] in type designation is determined by output (pulses/rev) of optical encoder as follows:
  - Standard: A (incremental 8000 pulses/rev)
  - Optional: S (absolute 8192 pulses/rev)

## 1.2 RATINGS AND SPECIFICATIONS OF SERVO DRIVER

Table 1.3

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Model | 1500r/min Series CIMR-S\J- | 03\ | 04\ | 06\ | 08\ | | 11\ | 15\ | 22\ | 30\ | 37\ |
| | 750r/min Series CIMR-S\J- | 03L | — | 04L | 06L | 08L | 11L | 15L | 19L | — | — |
| Rated Capacity kVA | | 6 | 9 | 13 | 18 | | 25 | 35 | 45 | 60 | 80 |
| Rated Current A | | 18 | 27 | 40 | 55 | | 80 | 110 | 135 | 190 | 240 |
| Power Supply | Main | 240 to 340 VDC | | | | | | | | | |
| | Control | 210 to 310 VDC | | | | | | | | | |
| | Fan | Single-phase 200/220\AC $^{+10\%}_{-15\%}$ 50/60Hz ±5% | | | | | | | | | |
| Overcurrent Capacity | | 200% 10 sec | | | | | | | | | |
| Rated Output Voltage | | Three-phase 190\ (in 300\DC input) | | | | | | | | | |
| Inverter Type | | Transistorized PWM inverter | | | | | | | | | |
| Control Method | | Vector control (digital control) | | | | | | | | | |
| Control Specifications | Speed — Control Range | 1:3000 or more | | | | | | | | | |
| | Speed — Accuracy | Analog ref: ±0.2% (25±10℃) | | | | | | | | | |
| | Speed — Frequency Characteristic | 400rad/s | | | | | | | | | |
| | Torque — Repeatability | ±2% (±0.5%*1) | | | | | | | | | |
| | Accel/Decel Time Setting | 0 to 10s (in unit of 2ms) | | | | | | | | | |
| I/O Signals | Speed Reference *2 | ±6\ at rated speed(±10\ at rated speed: optional) | | | | | | | | | |
| | Torque Reference *2 | ±3V at rated torque(±6V at rated torque: optional) | | | | | | | | | |
| | Torque Limit *2 | FWD/REV run torque limit:+3V/100% | | | | | | | | | |
| | Sequence Input | Servo ready, servo O\, emergency stop, fault reset, integral reset, ASR constant selection (4 types), low speed selection, sensor O\, synchronous signal, reference input prohibition, torque/speed selection | | | | | | | | | |
| | Sequence Output | Completion of servo ready, running, zero speed, fault, alarm, answer signal | | | | | | | | | |
| | Speed (Positioning) Signal Output | Dividing ratio: 1/\ or 2/\ (\: 1 to 32) *2<br>Dividing ratio: \/8192 (\: set value) *3 | | | | | | | | | |
| Contained Functions | Protective Functions | Overcurrent, overvoltage, undervoltage, overload, overspeed, blown fuse, heatsink overheat, motor overheat | | | | | | | | | |
| | Indication | input, output, fault | | | | | | | | | |
| | Monitor Output — Speed | ±6V at ±100% | | | | | | | | | |
| | Monitor Output — Torque | ±3V at ±100% | | | | | | | | | |
| | Monitor Output — Current | +5V at 100% | | | | | | | | | |
| Conditions | Ambient Temperature and Humidity | • Operation: 0 to +55℃, 90 % RH or less (non-condensing)<br>• Storage: −20 to +60℃, 90 % RH or less (non-condensing) | | | | | | | | | |
| | Height | 1000 meters max. at indoor | | | | | | | | | |
| | Ambient Atomosphere | Free from corrosive gases and dust | | | | | | | | | |
| | Vibration | 0.5G or below | | | | | | | | | |

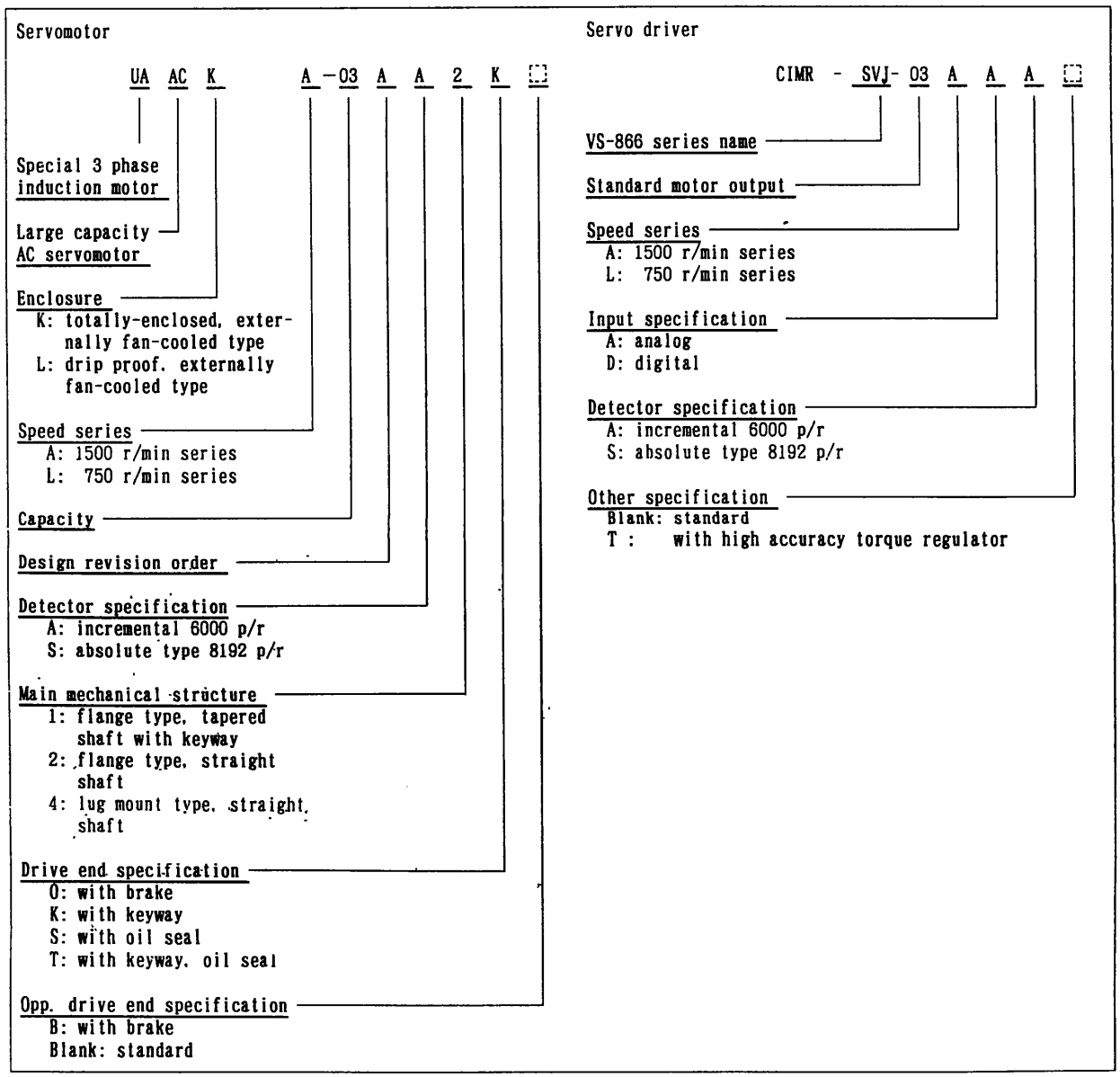
*1 For option (with high precision torque controller).
*2 For incremental encoder.
*3 For absolute encoder.

## 1.3 RATINGS AND SPECIFICATIONS OF POWER UNIT

Table 1.4

| Power Unit Model | | NPSN-0303L | NPSO-0503L | NPSO-0803L | NPSO-1303L |
|---|---|---|---|---|---|
| Rated Output kw(HP) | | 7.5 (10) | 15 (20) | 25 (34) | 40 (54) |
| Input Power | Power Supply | 3 phase, 200/220 VAC (+10%−15%) 50/60 Hz | | | |
| | Capacity kVA | 10 | 20 | 30 | 50 |
| DC Output | Rated Voltage | 300 VDC for 220 VAC input | | | |
| | Rated Current ADC | 25 | 50 | 80 | 130 |
| | Overcurrent Capacity | 200% 10 s | | | |
| Control Power Output | Voltage | 300 VDC for 200 VAC input | | | |
| | Current | 2 ADC for up to 4 drives | | | |

## 1.4 MODEL DESIGNATION

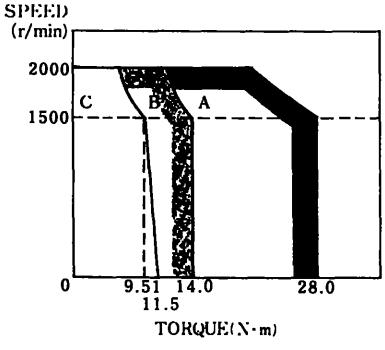


# 2. CHARACTERISTICS

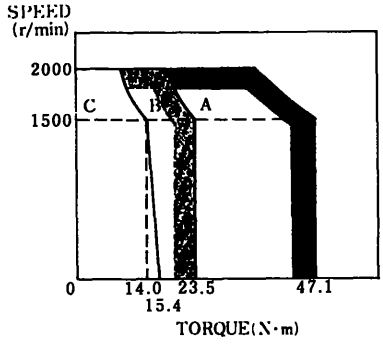
## 2.1 SPEED-TORQUE CHARACTERISTICS

(1) 1500r/min Series

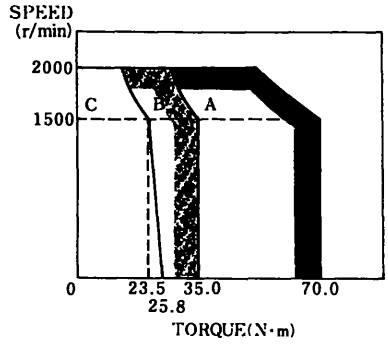
UAACKA-03A 2.2/1.5kW



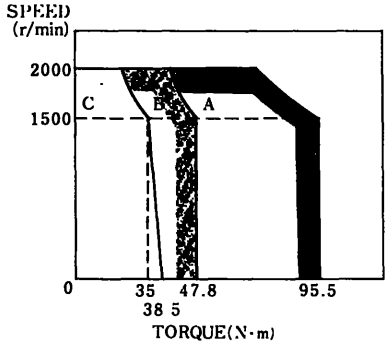

UAACKA-04A 3.7/2.2kW



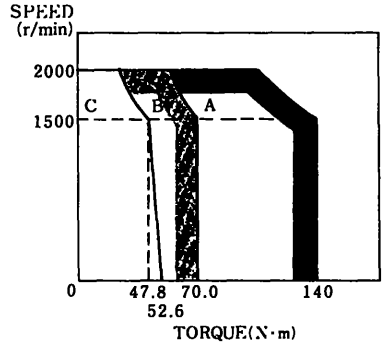

UAACKA-06A 5.5/3.7kW



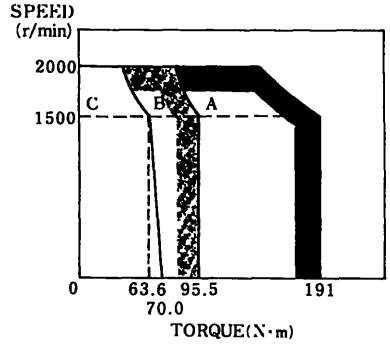

UAACKA-08A 7.5/5.5kW



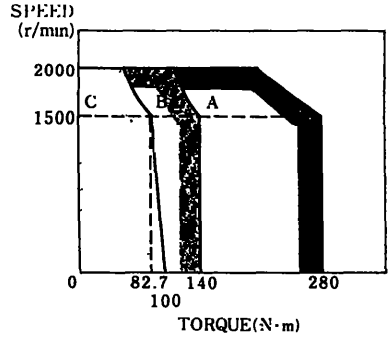

UAACKA-11A 11/7.5kW



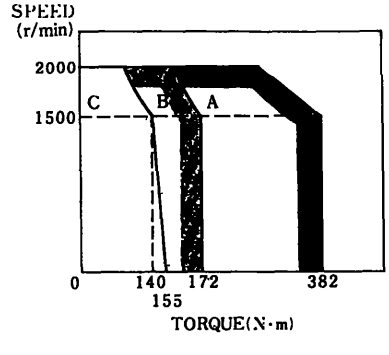

UAACKA-15A 15/11kW



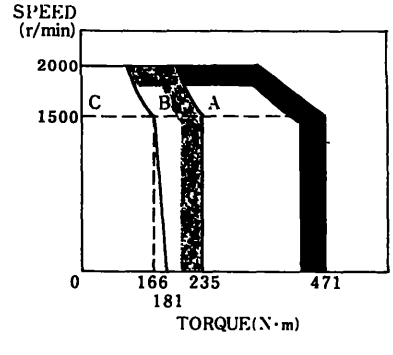

UAACLA-22A 22/13kW




UAACLA-30A 30/22kW




UAACKA-37A 37/26kW

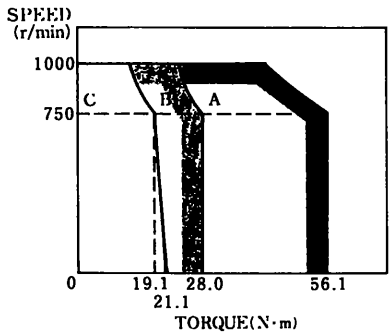



A ···INTERMITTENT DUTY ZONE
B ···50% ED DUTY ZONE
C ···CONTINUOUS DUTY ZONE

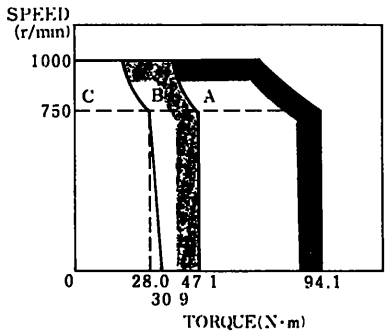
Note: The range between 1500 and 2000r/min is constant output characteristics.

(2) 750 r/min Series

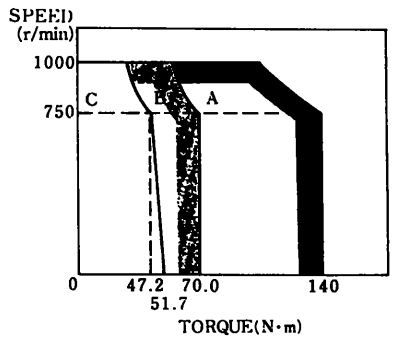
UAACKA-03A 2.2/1.5kW



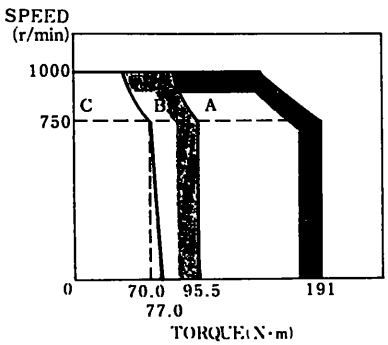

UAACKA-04A 3 7/2.2kW



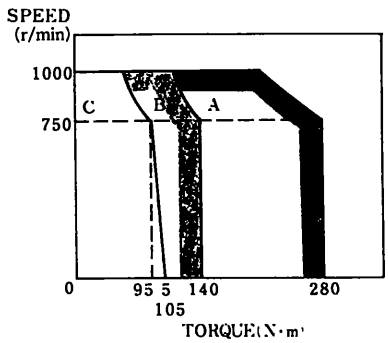

UAACKA-06A 5.5/3.7kW



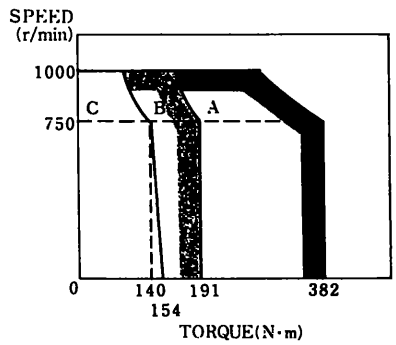

UAACKA-08A 7.5/5.5kW



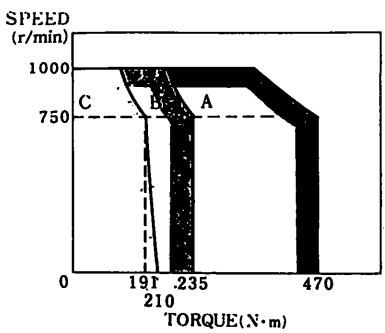

UAACKA-11A 11/7.5kW




UAACLL-15A 15/11kW




UAACLL-19A 18.5/15kW




A ···INTERMITTENT DUTY ZONE
B ···50% ED DUTY ZONE
C ···CONTINUOUS DUTY ZONE

Note: The range between 750 and 1000r/min is constant output characteristics.

## 2.2 MECHANICAL CHARACTERISTICS OF MOTOR

### 2.2.1 Shaft Coupling Method

A direct coupling is standard for drive method between motor shaft and load.
In case of a belt drive type, the radial load on shaft increases.
For allowable radial load on shaft, refer to par. 2.2.4.

### 2.2.2 Motor Fastening Bolts

For fastening the motor flange, use hexagon socket head bolts (JIS B1176, strength division 10.9).
For tightening torque for motor fastening bolts, refer to Table 2.1.

### 2.2.3 Mechanical Strength

The servo motor output shaft stands up to 200% of instantaneous peak torque.
Contact your Yaskawa representative for the following cases.

- $J_L$ is more than 5 times $J_M$
- Winding change unit is optionally used

### 2.2.4 Allowable Radial and Thrust Loads

Tables 2.2 and 2.3 show the allowable load to servo motor output shaft.
Contact your Yaskawa representative for the following cases.

- Radial load point closes to the drive end from center of the output shaft
- $J_L$ is more than 5 times $J_M$
- Winding change unit is optionally used

**Table 2.1 Tightening Torque for Motor Set Bolts**

| Motor Model | | Bolt Size | Bolt Tightening Torque kg·cm(lb in) |
|---|---|---|---|
| 1500 rpm Series | 750 rpm Series | | |
| UAACKA-03AA2K | — | M12 | 610 (529.5) |
| UAACKA-04AA2K | — | | |
| UAACKA-06AA2K | UAACKL-03AA2K | | |
| UAACKA-08AA2K | UAACKL-04AA2K | M12 | 610 (529.5) |
| UAACKA-11AA2K | UAACKL-06AA2K | | |
| UAACKA-15AA2K | UAACKL-08AA2K | | |
| UAACKA-22AA2K | UAACKL-11AA2K | M16 | 950 (824.7) |
| UAACLA-30AA2K | UAACLL-15AA2K | | |
| UAACLA-37AA2K | UAACLL-19AA2K | | |

Table 2.2 Load Allowable to Output Shaft of 1500 rpm Series

| Motor model | Allowable Radial Load kg(lb) | Allowable Thrust Load kg(lb) |
|---|---|---|
| UAACKA-03AA2K | 210 (463) | 90 (198) |
| UAACKA-04AA2K | 220 (485) | 90 (198) |
| UAACKA-06AA2K | 220 (485) | 90 (198) |
| UAACKA-08AA2K | 330 (727) | 135 (297) |
| UAACKA-11AA2K | 340 (749) | 150 (330) |
| UAACKA-15AA2K | 280 (617) | 170 (374) |
| UAACKA-22AA2K | 510 (1123) | 220 (485) |
| UAACLA-30AA2K | 510 (1123) | 220 (485) |
| UAACLA-37AA2K | 510 (1123) | 220 (485) |

Table 2.3 Load Allowable to Output Shaft of 750 rpm Series

| Motor Model | Allowable Radial Load kg(lb) | Allowable Thrust Load kg(lb) |
|---|---|---|
| UAACKL-03AA2K | 220 (485) | 90 (198) |
| UAACKL-04AA2K | 330 (727) | 135 (297) |
| UAACKL-06AA2K | 340 (749) | 150 (330) |
| UAACKL-08AA2K | 280 (617) | 170 (374) |
| UAACKL-11AA2K | 510 (1123) | 220 (485) |
| UAACLL-15AA2K | 510 (1123) | 220 (485) |
| UAACLA-19AA2K | 510 (1123) | 220 (485) |

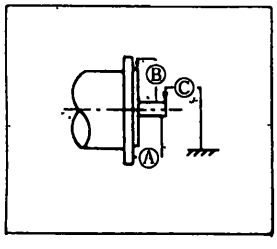
### 2.2.5 Machining Accuracy

Table 2.4 shows the accuracy of servo motor output shaft and counterpart to mount on.

Table 2.4 Machining Accuracy Unit mm (inch)

| Motor Model | | Accuracy (T.I.R.) | | |
|---|---|---|---|---|
| 1500 rpm Series | 750 rpm Series | Flange Surface Perpendicular to Shaft Ⓐ | Flange Diameter Concentric to Shaft Ⓑ | Shaft Run Out Ⓒ |
| UAACKA-03AA2K | – | 0.04 (0.0016) | 0.04 (0.0016) | 0.02 (0.0008) |
| UAACKA-04AA2K | – | | | |
| UAACKA-06AA2K | UAACKL-03AA2K | | | |
| UAACKA-08AA2K | UAACKL-04AA2K | | | 0.022 (0.0009) |
| UAACKA-11AA2K | UAACKL-06AA2K | | | |
| UAACKA-15AA2K | UAACKL-08AA2K | | | |
| UAACKA-22AA2K | UAACKL-11AA2K | 0.056 (0.039) | 0.05 (0.002) | |
| UAACLA-30AA2K | UAACLL-15AA2K | | | |
| UAACLA-37AA2K | UAACLL-19AA2K | | | |

Note: T.I.R. denotes Total Indicator Reading on dial gauge.



## 3. STANDARD COMBINATION

(1-motor dvive, No regenerative load, Decel. time duty 20% ED max.)

Table 3.1 1500 r/min Series

| Servomotor | | Servo Driver | | Power Unit*1 | | When $J_L \leq 2 \times J_M$ *2 | | | | When $J_L \leq 5 \times J_M$ *2 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Capacity kW(HP) | Model UAACKA- | Capacity kVA | Model CIMR-SVJ- | Capacity kW(HP) | Model | No. of Braking Resistors*3 | No. of Braking Units*4 | Thermal Relay*5 Model | Thermal Relay*5 Q'ty | No. of Braking Resistors*3 | No. of Braking Units*4 | Thermal Relay*5 Model | Thermal Relay*5 Q'ty |
| 2.2 (3) | 03A□□□ | 6 | 03A□□□ | 7.5 (10) | VPSN-0303L | Unnecessary | | | | Unnecessary | | | |
| 3.7 (5) | 04A□□□ | 9 | 04A□□□ | 7.5 (10) | VPSN-0303L | | | | | 1 | 1 | RH18-1.7P | 1 |
| 5.5 (7.5) | 06A□□□ | 13 | 06A□□□ | 7.5 (10) | VPSN-0303L | | | | | 1 | 1 | RH18-1.7P | 1 |
| 7.5 (10) | 08A□□□ | 18 | 08A□□□ | 15 (20) | VPSO-0503L | | | | | 1 | 1 | RH18-1.7P | 1 |
| 11 (15) | 11A□□□ | 25 | 11A□□□ | 15 (20) | VPSO-0503L | | | | | 2 | 1 | RH18-3P | 1 |
| 15 (20) | 15A□□□ | 35 | 15A□□□ | 25 (33) | VPSO-0803L | 1 | 1 | RH18-1.7P | 1 | 3 | 1 | RH18-5P | 1 |
| 22 (30) | 22A□□□ | 45 | 22A□□□ | 25 (33) | VPSO-0803L | 3 | 1 | RH18-5P | 1 | 5 | 1 | RH18-7P | 1 |
| 30 (40) | 30A□□□ | 60 | 30A□□□ | 40 (53) | VPSO-1303L | 6 | 2 | RH18-5P | 2 | 8 | 2 | RH18-7P | 2 |
| 37 (50) | 37A□□□ | 80 | 37A□□□ | 40 (53) | VPSO-1303L | 8 | 2 | RH18-7P | 2 | 10 | 2 | RH18-7P | 2 |

*1 Combination of power unit, braking resistors, braking units and thermal relays depends on operating conditions or system configuration.

*2 $J_L$ : Moment of load inertia (kg·cm², lb in·s²×10⁻¹)
$J_M$ : Moment of motor inertia ( kg·cm² lb in·s²×10⁻¹)

*3 Braking resistor is GRZG 600W, 30Ω (R007195) manufactured by Nippon Resistor Mfg. Co., Ltd.

*4 Braking unit is CDBR-2022 manufactured by Yaskawa.

*5 Thermal relay is manufactured by Yaskawa.

Table 3.2 Connector Cable for Detector (Provided by user)

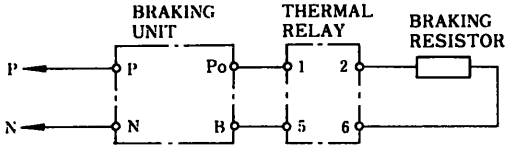
| | |
|---|---|
| Receptacle | MS3102A20-29P |
| Plug | L type: MS3108B20-29S<br>Straight: MS3106B20-29S |
| Cable Clamp | MS3057-12A |
| Cable | DP8409179 |

Note: Connector (1CN; 2CN) for servo driver is attached.

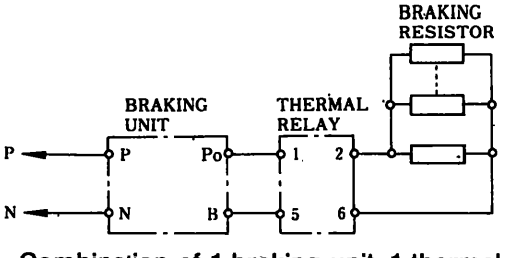
Table 3.3 750 r/min Series

| Servomotor | | Servo Driver | | Power Unit*1 | | When $J_L \leq 2 \times J_M$ *2 | | | | When $J_L \leq 5 \times J_M$ *2 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Capacity kW(HP) | Model UAACKA- | Capacity kVA | Model CIMR-SVJ- | Capacity kW(HP) | Model | No. of Braking Resistors*3 | No. of Braking Units*4 | Thermal Relay*5 Model | Thermal Relay*5 Q'ty | No. of Braking Resistors*3 | No. of Braking Units*4 | Thermal Relay*5 Model | Thermal Relay*5 Q'ty |
| 2.2 (3) | 03A□□□ | 6 | 03L□□□ | 7.5 (10) | NPSA-0303L | Unnecessary | | | | Unnecessary | | | |
| 3.7 (5) | 04A□□□ | 13 | 04L□□□ | 7.5 (10) | NPSA-0303L | | | | | | | | |
| 5.5 (7.5) | 06A□□□ | 18 | 06L□□□ | 7.5 (10) | NPSA-0303L | | | | | | | | |
| 7.5 (10) | 08A□□□ | 18 | 08L□□□ | 15 (20) | NPSO-0503L | | | | | | | | |
| 11 (15) | 11A□□□ | 25 | 11L□□□ | 15 (20) | NPSO-0503L | | | | | 1 | 1 | RH18-1.7P | 1 |
| 15 (20) | 15A□□□ | 35 | 15L□□□ | 25 (33) | NPSO-0803L | | | | | 1 | 1 | RH18-1.7P | 1 |
| 18.5 (25) | 19A□□□ | 45 | 19L□□□ | 25 (33) | NPSO-0803L | | | | | 2 | 1 | RH18-3P | 1 |

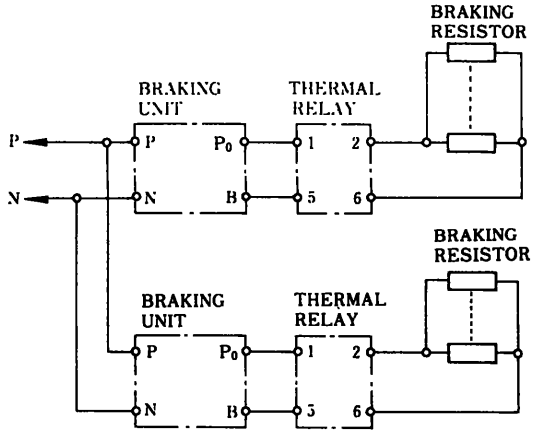
*1 Combination of power unit, braking resistors, braking units and thermal relays depends on operating conditions or system configuration.
*2 $J_L$ : Moment of load inertia (kg·cm², lb in·s²×10⁻¹)
$J_M$ : Moment of motor inertia ( kg·cm², lb in·s²×10⁻¹)
*3 Braking resistor is GRZG 600W, 30Ω manufactured by Nippon Resistor Mfg. Co., Ltd.
*4 Braking unit is CDBR-2022 manufactured by Yaskawa.
*5 Thermal relay is manufactured by Yaskawa.




(a) Combination of 1 each braking unit, thermal relay and braking resistor.




(b) Combination of 1 braking unit, 1 thermal relay and 2 to 5 braking resistors.




(c) Combination of 2 braking units, 2 thermal relay and several braking resistors.

Fig. 3.1 Connection of Braking Resistors, Braking Units and Thermal Relays (for Standard Combinations)

# 4. FUNCTIONS

## 4.1 CONTROL FUNCTIONS

VS-866 can select a control mode according to use by constants (internal memory switch) or sequence input. See Table 4.1 and Fig. 4.1.

**Table 4.1 Control Mode**

| Control Mode | Select signal | | Description | Remarks |
|---|---|---|---|---|
| | TOCM * | TSEL † | | |
| Speed Control I | OFF | Invalid | • Motor speed is controlled by speed reference.<br>• Forward, reverse or particular torque limit can be referenced externally. | 3 input references:<br>• Speed reference<br>• Forward torque limit<br>• Reverse torque limit |
| Speed Control II | ON | Open | • Motor speed is controlled by speed reference.<br>• Torque limit (same value for forward and reverse) is controlled externally. | 2 input references:<br>• Speed reference<br>• Torque limit |
| Torque Control | | Close | • Motor torque is controlled by torque reference.<br>• Speed limit is referenced externally. | 2 input references:<br>• Torque reference<br>• Speed limit |

*1 TOCM is a memory switch (least-significant bit of select/set value Cn30). When TOCM is set at ON, the switching between speed control II and torque control by open/close of TSEL is possible during run.

*2 TSEL is sequence input (1CN-43).

Note:
1. Speed control I (TOCM:OFF) is pre-set at the factory. TOCM is operated on monitor panel.

2. In speed control (I, II) mode, operation without external torque limit (without torque limit reference) is available by selecting via memory switch.

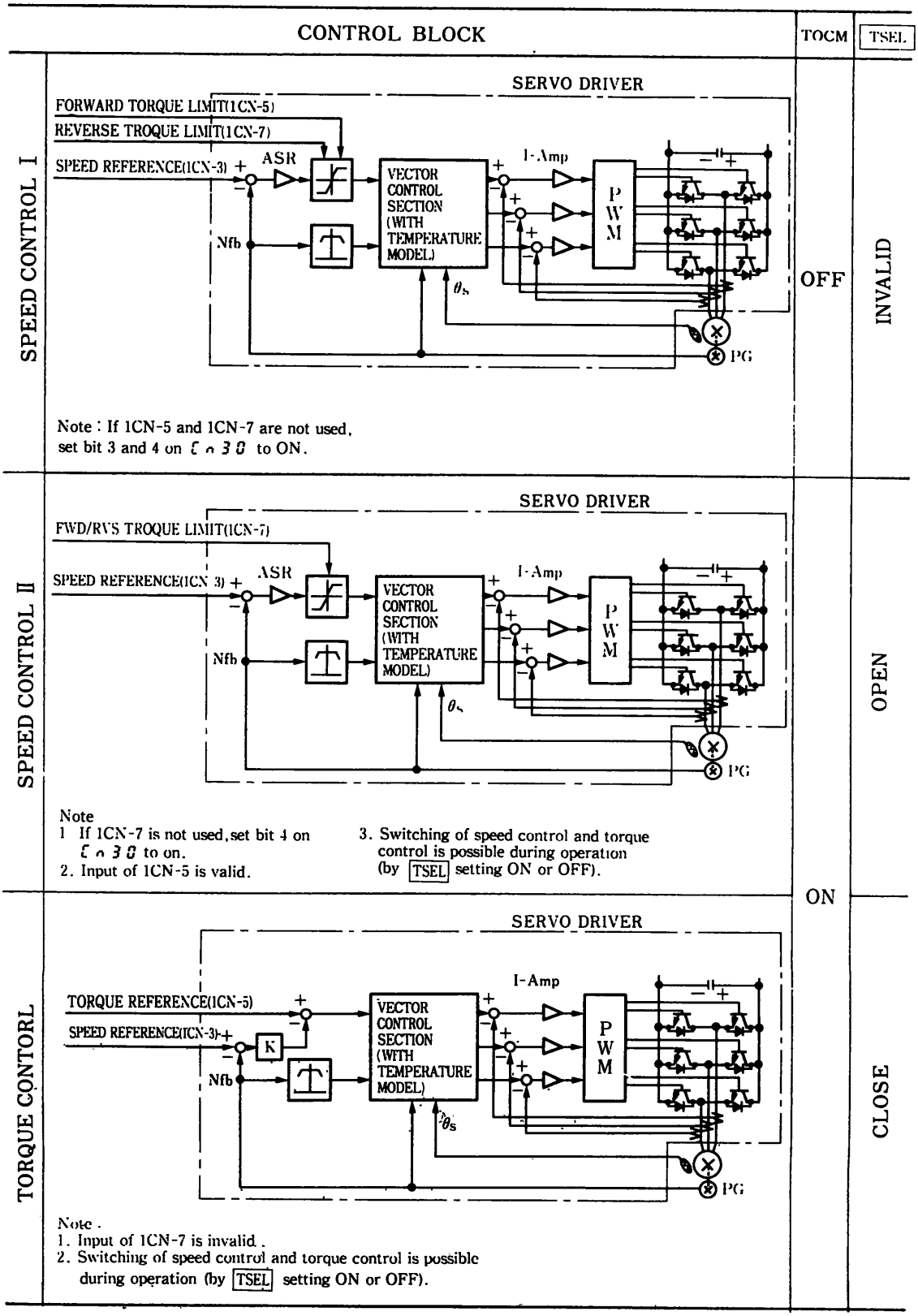



Fig 4 - 1 Control Function Block Diagram

## 4.2 STATUS MONITOR FUNCTIONS

Status monitor function (Table 4.2) is provided for various drive-run status functions. Keying on a monitor panel displays a desired status on LED.
(For details, refer to Sect. 9. MONITOR PANEL OPERATION.)

Table 4.2 Status Monitor Functions

| Monitor Display | Abbreviation | Name | Unit | Resolution | Remarks |
|---|---|---|---|---|---|
| Un01 | NREF | Speed reference | % | 0.1 | — |
| Un02 | NFB | Speed feedback | r/min | 1 | — |
| Un03 | TREF | Torque reference | % | 0.1 | — |
| Un04 | TFB | Torque feedback | % | 0.1 | When high accuracy torque regulator is provided |
| Un05 | TLF | Forward torque limit | % | 0.1 | Mortoring under forward running, Regeneration under reverse running |
| Un06 | TLR | Reverse torque limit | % | 0.1 | Monitoring under reverse running, Regeneration under forward running |
| Un07 | I2R | Secondary current reference | % | 0.1 | — |
| Un08 | FLX | Magnetic flux reference | % | 0.1 | — |
| Un09 | I1R | Primary current reference | % | 0.1 | — |
| Un10 | SFR | Slip reference | % | 0.1 | — |
| Un11 | F1R | Primary frequency reference | Hz | 0.01 | — |
| Un12 | MTEMP | Motor temperature | ℃ | 1 | — |
| Un13 | VPN | Main circuit DC voltage | V | 0.1 | — |
| Un14 | STS | Status | HEX | - | See Table 9.3. |
| Un15 | SFTNO1 | Software No. 1 | - | - | Main unit |
| Un16 | SFTNO2 | Software No. 2 | - | - | Option |
| Un17 | 1ADD | CH1 AD data | HEX | | 7FFF/10V, 1CN-3 Input data |
| Un18 | 2ADD | CH2 AD data | HEX | | 7FFF/10V, 1CN-5 Input data |
| Un19 | 3ADD | CH3 AD data | HEX | | 7FFF/10V, 1CN-7 Input data |

## 4.3 PROTECTIVE FUNCTIONS

### 4.3.1 Protective Functions for Servo Driver

If an failure occurs during operation, a protective function is actuated to protect the equipment and the system. The failure is displayed on the monitor panel and is notified by a sequence output signal. VS-866 divides failure into 3 levels. According to the level, protective operation is selected. See Table 4.3.

**Table 4.3 Protective Functions for Servo Dirver**

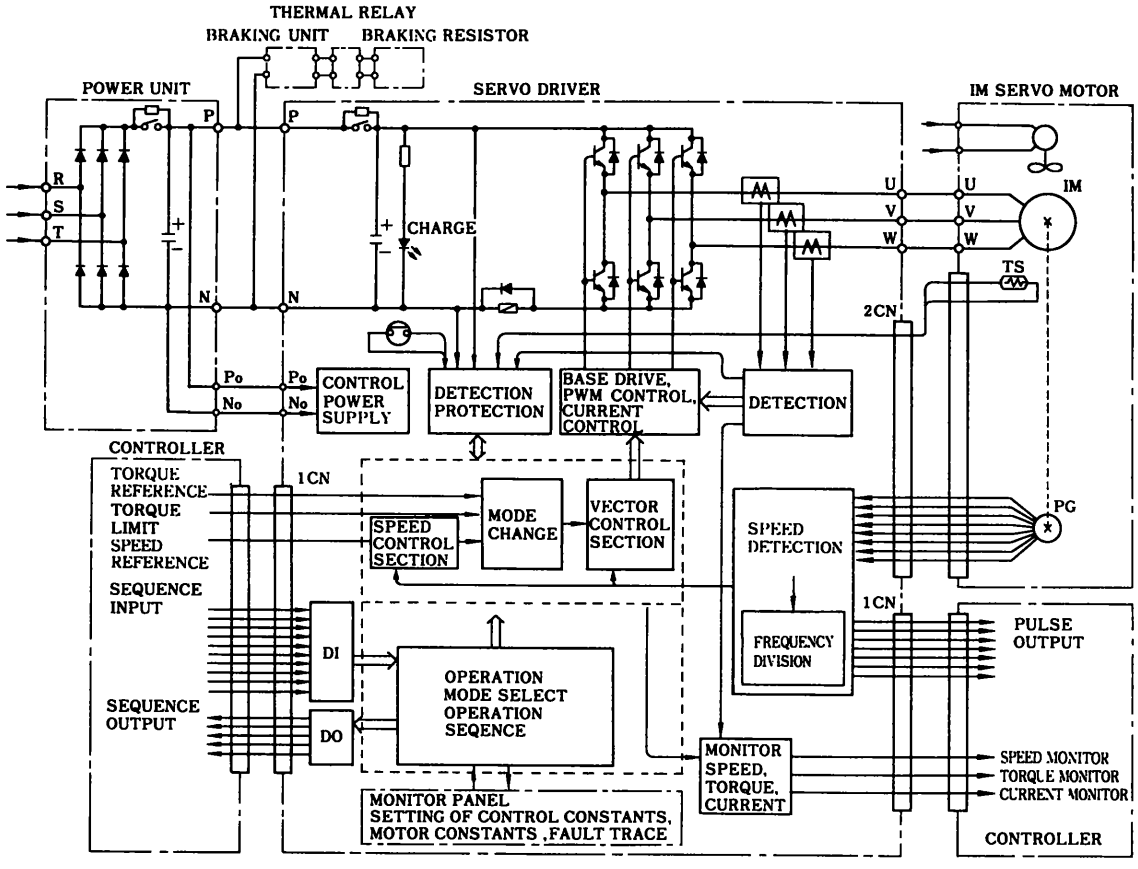
| Failure Level | | Protective Action | Monitor Panel Display | Sequence Output | Example |
|---|---|---|---|---|---|
| Low ↑ | Alarm | Operation can be continued, however, error A or B may result. Stop the operation immediately and check for the cause. | Detail of an error such as: oLn (motor overloaded) | ALM; ON (1CN 28) | • Servo driver overload (oL1) • Motor overload (oLn) • ABS PG (pulse generator) error (rPS) • Overvoltage 1 (oL) • Overcurrent 1 (CLR) |
| | Trouble A | Makes an emergency stop automatically and cuts off the power after stopping. (Coasting after braking stop) | Detail of an error such as: oHn (motor overheat) | FLT; ON (1CN 29) | • Servo driver overheat (oH1) • Motor overheat (oHn) • Excessive speed (oS) • Thermistor open circuit (oHL) • Main circuit low voltage(PUU), etc. |
| ↓ High | Trouble B | Current is cut off automatically. (Coasting immediately.) | Detail of an error such as: FU (fuse blown) | FLT; ON (1CN 29) | • Overcurrent 2 (oU) • Overvoltage 2 (oC) • Fuse blown (FU) • PG open circuit (PS) • Control circuit low voltage (CUU), etc. |

**Table 4.4 Protective Functions for Power Unit**

| Failure | Description | Contact | Status | Remarks |
|---|---|---|---|---|
| Fuse Blown | Unit fuse blown. Turn off the power. | 5-6 | ON (closed) | — |
| Overheat | Heat sink overheated. Stop operation. | 3-4 | ON (closed) | — |
| Magnetic Contactor Open | Magnetic contactor in unit is open. Stop operation. | 1-2 | OFF (open) | OFF before turning on the power. (Turned on after waiting approximately 0.3 second atfer turning on the power.) |

# 5. CONFIGURATION

## 5.1 FUNCTION BLOCK DIAGRAM




Note : See par 10.3 "Wiring Example" for detailed connection

**Fig. 5.1 Function Block Diagram**

## 5.2 INTERNAL SEQUENCE BLOCK DIAGRAM (Figs. 5.2, 5.3)

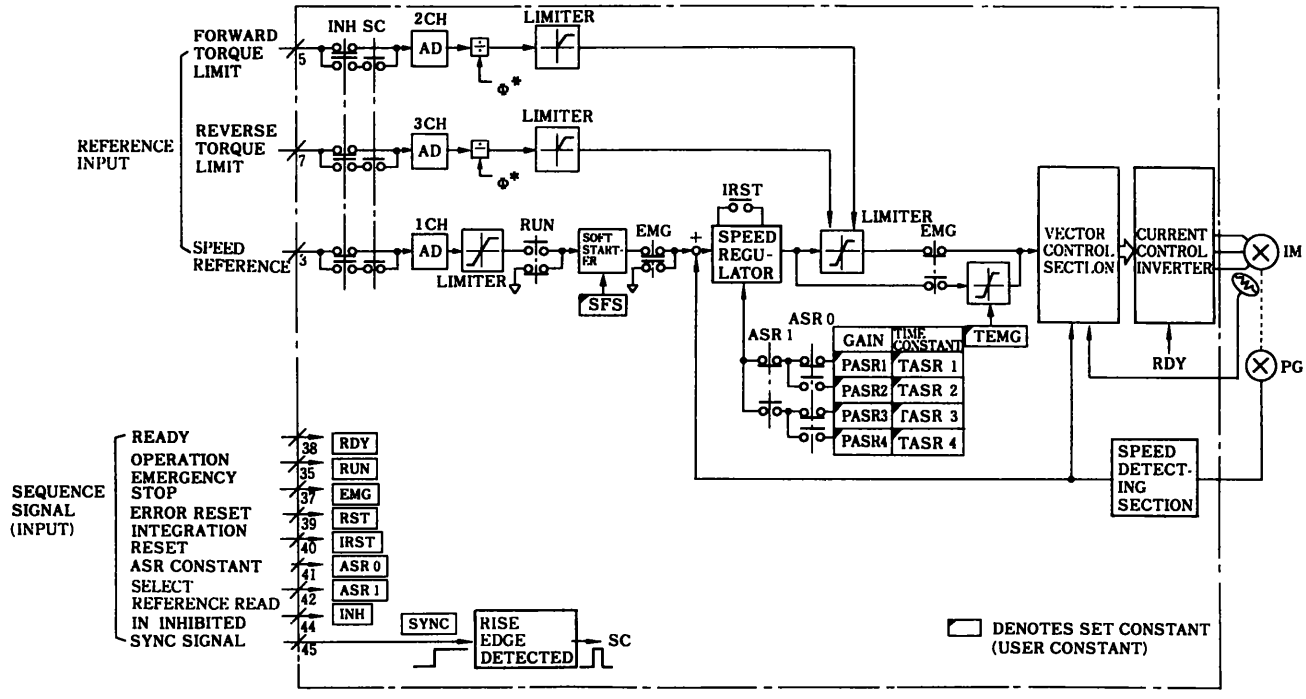
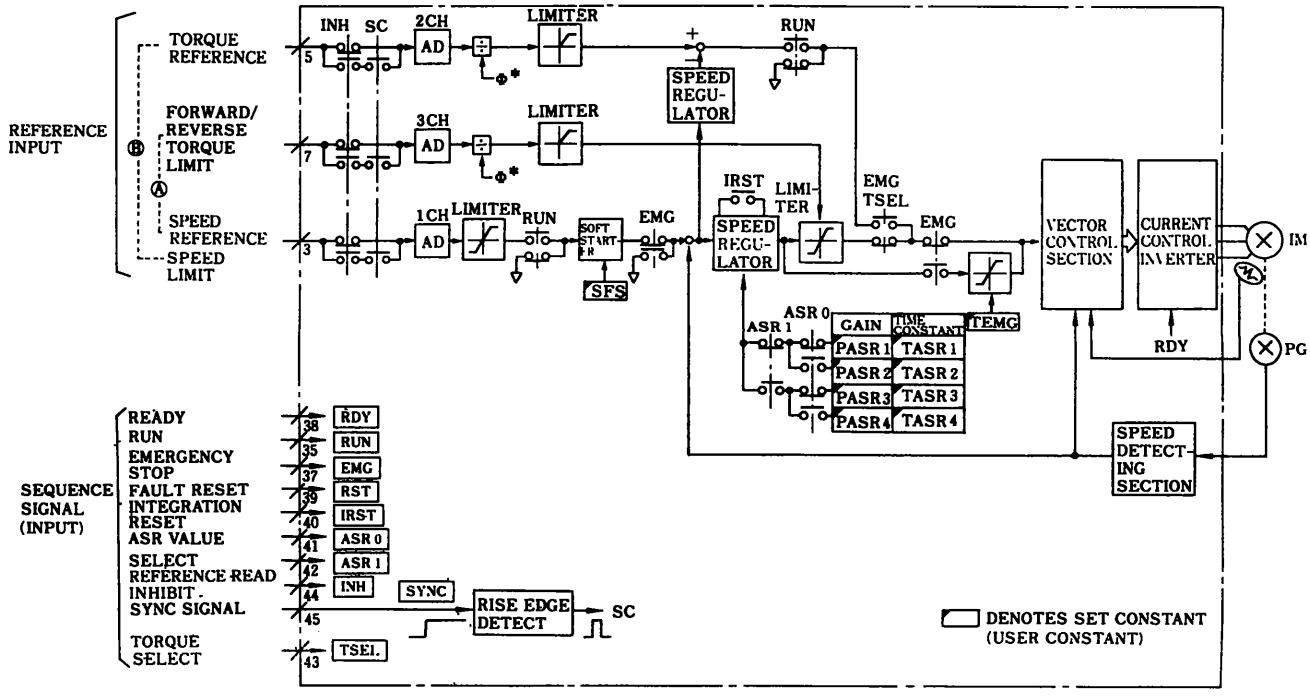



Fig. 5.2 Internal Sequence Block Diagram (Speed Control Ⅰ)




| TSEL | Control mode | Reference input 1CN-3 | 1CN-5 | 1CN-7 |
|---|---|---|---|---|
| ON | Torque control | Speed limit | Torque Reference | Invalid |
| OFF | Speed control | Speed Reference | Invalid | Torque limit |

Note: For reference input, only two inputs are effective by sequence signal " torque select " (TSEL).

Fig. 5.3 Internal Sequence Block Diagrgram (Speed Control Ⅱ, Torque Control)

# 6. CONTROL SIGNALS

## 6.1 SEQUENCE INPUT SIGNALS (1 CN 35 TO 46)

(1) Design the input signals, taking the following into consideration.
The relay ratings must be 30V or more and 20mA or more when a relay contact is used.
The signals delay roughly 1msec by the filter in the level conversion circuit of the input section.

(2) Fig. 6.1 shows the input circuit and Table 6.1 shows signal description.

(3) The ON/OFF states of the input signals can be checked by LED indication (Fig. 6.2) on the monitor panel. Refer to Par. 9, "MONITOR PANEL OPERATION."

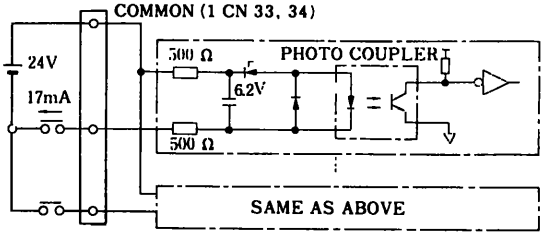



Fig. 6.1 Input Interface Circuit (Sequence Input)

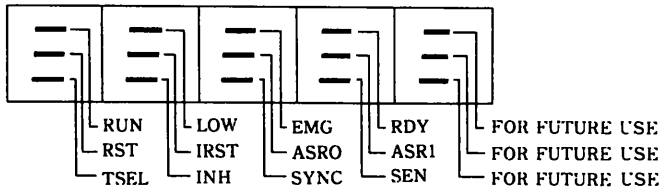



Fig. 6.2 Monitor Panel Displays (Sequence Input)

Table 6.1 Sequence Input Signals (1CN)

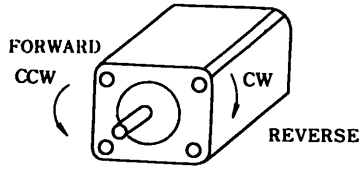
| Signal Name | Pin Number | On Signal | Description |
|---|---|---|---|
| Ready<br>RDY | 38 | Close | • An excitation current flows to motor if RDY is switched on. In about 0.5sec, a magnetic flux is established. (Preparations to start operation have been finished.)<br>• The motor is freed if RDY is switched off during operation. (Motor current is cut off by the base block of the power transistor in the main circuit.)<br>• Operation cannot be resumed unless RUN is switched off after switching off RDY |
| Run<br>RUN | 35 | Close | • The motor control state (SERVO ON) sets up by switching on RUN. Operation matching the reference starts.<br>• Switch on RDY. Wait more than 0.5sec and switch on RUN. (Approximately 0.5sec is needed to establish a magnetic flux.)<br>• During speed control:<br>The motor rotates counterclockwise* (CCW) by FWD-run reference voltage, and it rotates clockwise* (CW) by RVS-run reference voltage.<br>• During torque control mode:<br>The motor generates torque in a counterclockwise* (CCW) by FWD-run reference voltage, and it generates torque in a clockwise* (CW) by RVS-run reference voltage.<br>*Viewed from the load side<br>  |

**Table 6.1 Sequence Input Signals (1CN) (Cont'd)**

<table>
<tr><th>Signal Name</th><th>Pin Number</th><th>On Signal</th><th>Description</th></tr>
<tr><td>Run<br>RUN<br>(Cont'd)</td><td>35</td><td>Close<br>  </td><td>• Switch off RUN during operation to set the motor to:<br>(a) Operation ready state after deceleration and stopping. (Speed control mode)<br>(b) The motor generated torque becomes zero and assumes an operation ready state after stopping. (Torque control mode)</td></tr>
<tr><td>Emer-gency Stop<br>EMG</td><td>37</td><td>Open<br>  </td><td>• When switching off EMG during operation, the motor stops in an emergency.<br>• The motor braking torque (%) becomes the set value (Cn-17) if EMG is switched off. (100% is preset at the factory.)<br>• Switch off RUN temporarily and switch on RUN again to resume operation after switching off EMG. (Interlock is operating.)</td></tr>
<tr><td>ASR Select<br>ASR0<br>ASR1</td><td>41<br>42</td><td>Close<br>  </td><td>• Proportional gain and integration time of the speed controller (ASR) can be selected from four combinations of ON and OFF of ARS0 and ASR1
<table>
<tr><th rowspan="2"></th><th colspan="2">Input Signal</th><th colspan="2">ASR Constant</th></tr>
<tr><th>ASR0 (41)</th><th>ASR1 (42)</th><th>Proportional gain</th><th>Integral time</th></tr>
<tr><td>1</td><td>Open</td><td>Open</td><td>PASR1 (Cn04)</td><td>TASR1 (Cn05)</td></tr>
<tr><td>2</td><td>Close</td><td>Open</td><td>PASR2 (Cn06)</td><td>TASR2 (Cn07)</td></tr>
<tr><td>3</td><td>Open</td><td>Close</td><td>PASR3 (Cn08)</td><td>TASR3 (Cn09)</td></tr>
<tr><td>4</td><td>Close</td><td>Close</td><td>PASR4 (Cn10)</td><td>TASR4 (Cn11)</td></tr>
</table>
• ASR constants can be changed only if RUN is switched off and the revolution speed is zero. (Constants cannot be changed during operation.)</td></tr>
<tr><td>ASR Integ-ration Reset<br>IRST</td><td>40</td><td>Close<br>  </td><td>• Reset the integration value of the speed controller (ASR) to 0. The reset time is discharged by the time constant of the integration time.<br>• The speed control becomes P control if operated with IRST switched on<br>• Remaining under non-operation status for a long period, the motor can be prevented from rotating by the reference drift, etc. (at no load torque)</td></tr>
</table>

Table 6.1 Sequence Input Signals (1CN) (Cont'd)

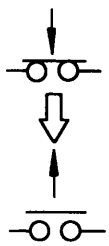
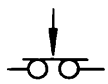
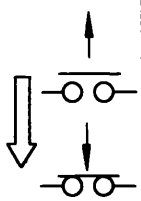
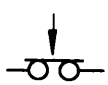
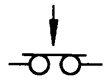
| Signal Name | Pin Number | On Signal | Description |
|---|---|---|---|
| Error Reset<br>RST | 39 | Close → Open<br>  | • If RST is switched on and off, memory of fault (FLT) and alarm (ALM) is reset. (Resetting is performed by the leading edge signal of RST.<br>• If fault (FLT) operates, reset it after removing the cause for the fault.<br>• Alarm (ALM) can be reset even during operation.<br>• Fault (FLT) can be reset only if RUN is switched off.<br>• The fault can be reset when momentary type pushbutton is depressed and then released. |
| Reference Read Inhibit<br>INH | 44 | Close<br>  | • Switch on INH to prohibit reading of reference input and to hold the value immediately before. If SYNC is switched off and then on, the value at this time is read. (Refer to par. 8(3).)<br>• Use INH in combination with SYNC only timing for reference switch is specially required.<br>• Reference input cannot be accepted if INH is switched on. Be sure to switch it off at all times. |
| Synchronizing Signal<br>SYNC | 45 | Open→ Close<br>  | • Use SYNC and INH together only when reference change timing is specially required.<br>• Switch SYNC off and then on again to synchronize scans of internal arithmetic operations of the servo driver by this timing. (Synchronization of scans)<br>• Switch SYNC off and then on again while INH is switched on, and reference input is read only once simultaneously with synchronization of scans.<br>(b) Switch it on normally. |
| Torque Control Select<br>TSEL | 43 | Close<br>  | • Becomes effective only if the internal memory switch TOCM (least significant bit of Cn30) is 1.<br>• Switch on TSEL to set up the torque control mode, controlling the motor shaft torque in accordance with the torque reference.<br>• Switch off TSEL to set up the Speed Control II mode, controlling the motor shaft revolution speed in accordance with the speed reference.<br>(See the sequence block diagram in par. 5.2.)<br>• By using INH and SYNC in combination, speed control and torque control can be switched at any timing during operation. (Refer to par. 8(3).)<br>• The control mode can be switched only by switching TSEL off and than on again. |

Table 6.1 Sequence Input Signals (1CN) (Cont'd)

| Signal Name | Pin Number | On Signal | Description |
|---|---|---|---|
| Sensor ON<br><br>SEN<br><br>Note: Valid for absolute encoder | 46 | Close<br>  | • Switch on SEN while RDY is switched off to read absolute value date from PG (refer to par. 6.5.2) and to start normal operation.<br>• Effective only if the absolute value encoder is used.<br>• Normally must be switched on.<br>• Becomes ineffective if RDY is switched on. (Disregarded during operation.) |
| Low Speed Select<br><br>LOW<br><br>(Option) | 36 | Close<br>  | • This signal is used when the winding change unit (option) is installed and is operated.<br>• Switch LOW on when RDY is switched off and the motor is stopped to select low-speed winding.<br>• Changes are not made during motor revolution or if RDY is switched on. |

## 6.2 REFERENCE INPUT SIGNALS (1CN 3 TO 8)

Design reference input signals (analog voltage references) taking the following conditions into consideration.

(1) Use twisted pair shielded wire for input signals and securely connect the shielded wire to pin 50 of 1CN.

(2) The maximum rating of input signals is ±15V. Design the system so that this voltage is not exceeded under any conditions.

(3) The input impedance is 10kΩ.

(4) Fig. 6.3 and Table 6.2 show the input circuit and signal description.

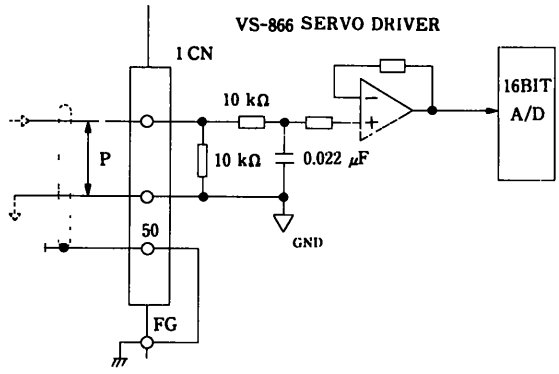



Fig. 6.3 Input Interface Circuit (Command Input)

Table 6.2 Input Reference Signals (1CN) (Cont'd)

| Signal Name | Pin Number | Description |
|---|---|---|
| Speed Reference NREF or Speed Limit NLIM | 3-4 (4;GND) | • The rated input voltage is ±6V DC or ±10V DC. Select 6 or 10V by SELCD2 (Cn30). (The voltage was preset to 6V at the factory prior to shipment.)<br>• The allowable input voltage is ±15V DC. Limited by 105% (6.3V) if the 6V controller is selected. Limited by 100% (10.0V) if the 10V controller is selected.<br>• The input impedance is 10kΩ.<br>• A speed reference is given if the speed control mode is selected. The reference voltage and motor speed have the following relationship. |

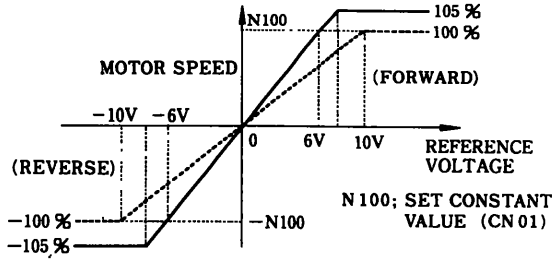
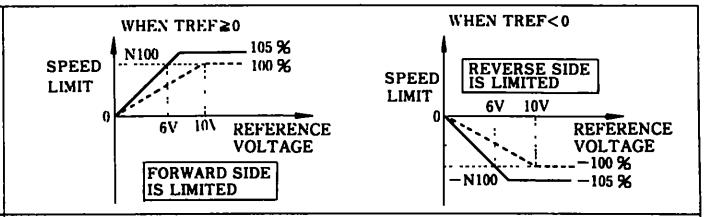


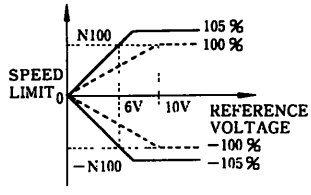
Table 6.2 Input Reference Signals (1CN) (Cont'd)

| Signal Name | Pin Number | Description |
|---|---|---|
| Speed Reference NREF or Speed Limit NLIM (Cont'd) | 3-4 (4;GND) | • Speed limit applies if the torque control mode is set. The relationship between the reference voltage and limit value is as follows. |

One side Limit (Standard)



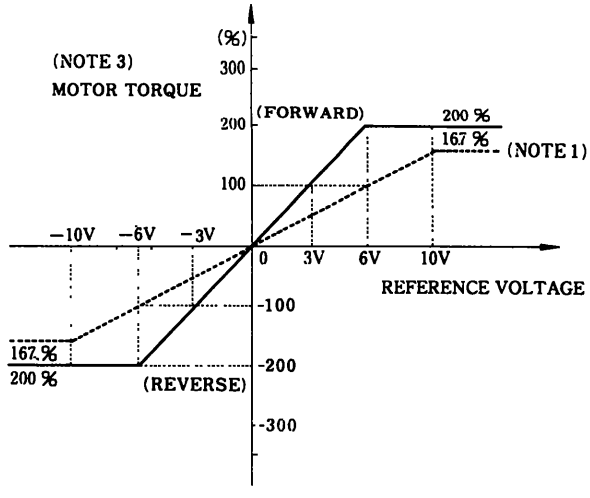

Both side Limit




Both forward and reverse directions are limited.

- NREF and NLIM become effective if the operation signal RUN is switched on.
- One-side (same polarity as torque reference) or both-side limit can be selected for speed limit NLIM. Select by SELCD2 (Cn30). One-side limit is preset at the factory prior to shipment.

| | | |
|---|---|---|
| Torque Reference TREF or Forward Torque Limit PTQL | 5-6 (6;GND) | • Torque reference applies during operation in the torque control mode operation. The relationship between the reference voltage and motor torque is shown below. |




Note:
1. Gain selection between 100%/3V and 100%/6V can be set by SELCD2 (Cn30). (100%/3V is preset at the factory prior to shipment.)
2. The rated motor torque is 100%.

Table 6.2 Input Reference Signals (1CN) (Cont'd)

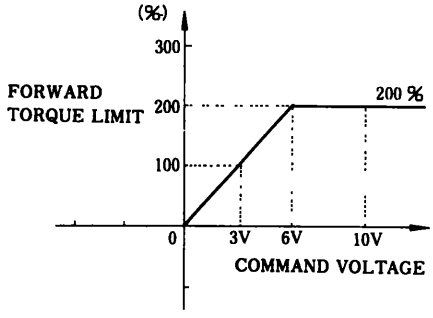
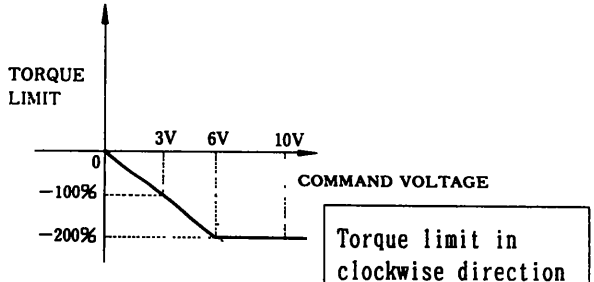
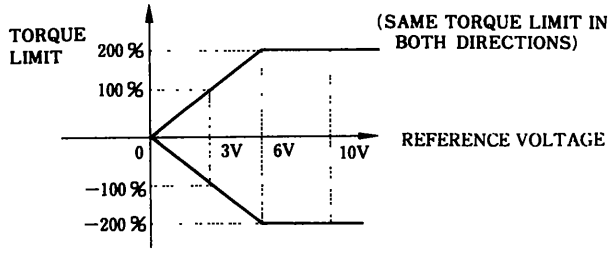
| Signal Name | Pin Number | Description |
|---|---|---|
| Torque Reference TREF or Forward Torque Limit PTQL (Cont'd) | 5-6 (6;GND) | • In operation in the speed control mode I, forward-side torque limit applies. The relationship between the reference voltage and torque limit value is as follows. The limit applies to the set torque.<br>  <br>Torque limit in counterclockwise direction viewed from load side.<br>Note:<br>1. Negative voltages are regarded as zero voltages.<br>2. No-use selection of torque limit references is possible in accordance with the selection of SELCD2 (Cn30).<br>• This input becomes ineffective if operation is in the speed control mode II. |
| Reverse Torque Limit NTQL or Both Side Torque Limit ATQL | 7-8 (8;GND) | • In operation in the speed control mode I, reverse-side torque limit applies. The relationship between the reference voltage and torque limit value is as follows.<br>  <br>Torque limit in clockwise direction viewed from load side.<br>Note:<br>1. Negative voltages are regarded as zero voltages.<br>2. No-use selection of torque limit references is possible in accordance with the selection of SELCD2 (Cn30). |

Table 6.2 Input Reference Signals (1CN) (Cont'd)

| Signal Name | Pin Number | Description |
|---|---|---|
| Reverse Torque Limit<br>NTQL<br>or<br>Both Side Torque Limit<br>ATQL<br>(Cont'd) | 7-8<br>(8;GND) | • Both-direction torque limit sets if operation is in the speed control mode II. The relationship between the reference voltage and torque limit value is as follows.<br>  <br><br>Note:<br>1. Negative voltages are regarded as zero voltages.<br>2. No-use selection of both-direction torque limit is possible by SELCD2 (Cn30). |

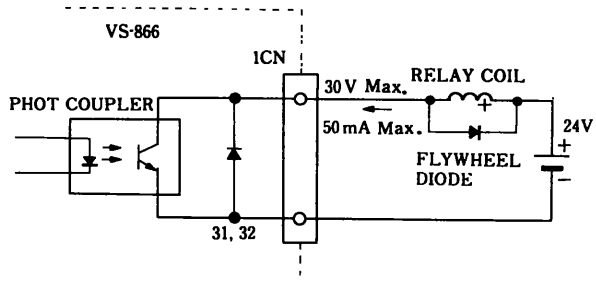
## 6.3 SEQUENCE OUTPUT SIGNALS

(1) Use the output signals under the following conditions.
- The output circuit uses a photo coupler. The capacity is 24V DC 50mA.
- Be sure to connect a flywheel diode parallel to the coil when switching an inductive load such as an external relay on and off. (Connect with the correct polarities.)
- Connect a protective resistor in series to the load due to current limit the load is a capacitive load.

(2) Fig. 6.4 and Table 6.3 show the output circuit and signal description.

(3) Output signal on/off state can be checked by LED indication on the monitor panel (see Fig. 6.5). Refer to par. 9 for the operating method.

(4) After the power is turned on, it takes approximately 1 second maximum until sequence output signal operates normally. When the power is turned on, it takes approximately 1 second maximum (200 to 300 ms) for initial set of servo driver.




Note that all photo coupler emitters are commoned (1CN 31, 32).

Fig. 6.4 Output Interface Circuit

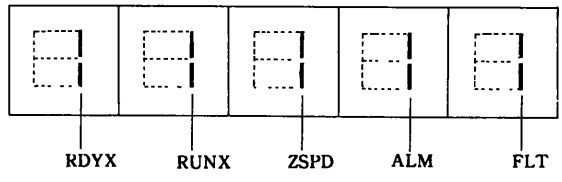



Fig. 6.5 Monitor Panel Display

Table 6.3 Sequence Output Signals (1CN)

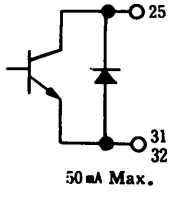
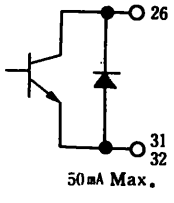
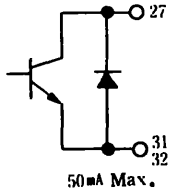
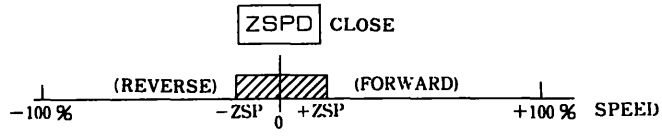
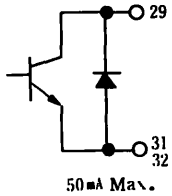
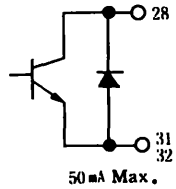
| Signal Name | Pin No. | Description |
|---|---|---|
| Ready<br>RDYX |  | • Switches on when the servo driver is ready to be operated.<br>• Switches off if trouble occurs with the driver. Does not switch off on the alarm level.<br>• An excitation current flows to the motor if RDYX is switched on.<br>• RDYX does not switch off by input of the EMG reference. |
| Run<br>RUNX |  | • Switches on during servo operation. (Servo on)<br>• Operates when the RUN reference is switched on. Operation condition continues until the speed slows below the zero-speed level by switching off the RUN reference.<br>• Switches off if the driver is faulty, if the RDY reference is switched off, or if the EMG reference is switched on. |

Table 6.3 Sequence output Signals (1CN) (Cont'd)

| Signal Name | Pin No. | Description |
|---|---|---|
| Zero Speed<br>ZSPD |  | • Switches on if the motor speed becomes lower than the set value (Cn13 ZSP).<br>• Holds for 50msec or more, once operated.<br>  |
| Trouble<br>FLT |  | • FLT is output simultaneously and the motor rapidly decelerates and stops or makes coasting stop if an overcurrent or overload protection function operates.<br>• Reset FLT by inputting RST after removing the trouble cause.<br>• Switch off the RUN input and then switch on to resume operation after a stop by FLT |
| Alarm<br>ALM |  | • An alarm is output on the level before trouble occurs, trouble prevention operation such as current limit is performed, and ALM is output simultaneously with detection of an alarm.<br>• Input RST after removing the trouble cause before resetting ALM |

## 6.4 MONITORING ANALOG OUTPUT SIGNALS

Use monitoring analog output signals under conditions as shown in Table 6.4.

**Table 6.4 Monitoring Analog Output Signals**

<table>
<tr><th>Signal Name</th><th>Output Signal Level</th><th>Description</th></tr>
<tr><td>Speed Monitor<br><br>NMONI<br><br>1CN 19-20<br>(20:GND)</td><td>±6V/±100%<br><br>±10V max.<br><br>Load impedance 2kΩ min.</td><td>• The motor speed can be monitored by connecting a voltmeter externally.<br>• Connect a voltmeter of the following specifications when connecting to the voltmeter for speedometer.<br>• Outputs by 12-bit DA converter.<br><table><tr><th></th><th>Specifications</th></tr><tr><td>Type</td><td>Voltmeter</td></tr><tr><td>Operating principle</td><td>Moving coil type</td></tr><tr><td>Rated current</td><td>1mA</td></tr><tr><td>Class</td><td>2.5 or higher</td></tr></table>• Output is performed every sampling time of 2msec.</td></tr>
<tr><td>Torque Monitor<br>TMONI<br><br>1CN 21-22<br>(22:GND)</td><td>±10V max.<br><br>±3V/100%<br><br>2kΩ min.</td><td>• Motor torque can be monitored by connecting a voltmeter externally.<br>• The voltmeter specifications are the same as those for the speed monitor above.<br>• Output is performed every sampling time of 2sec.<br>• Outputs by 12-bit DA converter.</td></tr>
<tr><td>Current Monitor<br>IMONI<br><br>1CN 48-49<br>(49:GND)</td><td>±5V/100%<br><br>Servo driver rating<br><br>2kΩ min.</td><td>• The voltmeter specifications are the same as those for the speed monitor above.<br>• Motor current (3-phase) detect signal is output at 3-phase full-wave rectified.</td></tr>
</table>

Note: Analog output for monitor is a control signal Therefore, the cable should be separated from main circuit cables and other power cables and as short as possible (20 meters or below for shielded cables). If the cable is extended, be sure to insulate by using isolator.

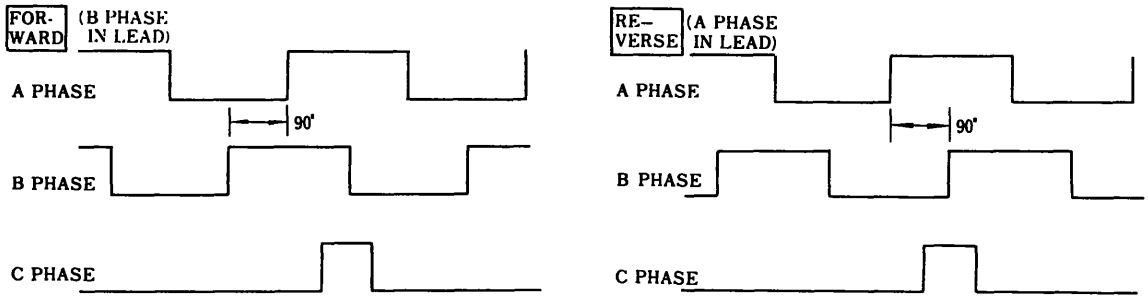
## 6.5 ENCODER (PG) PULSE OUTPUT CIRCUIT (PAO, *PAO, PBO, *PBO, PCO, *PCO)

### 6.5.1 Incremental Encoder (Standard)

Phases A, B and C (original point) signals for PG (6000 pulses/rev) are output. Use these signals as positioning signals. The output signal specifications are as follows.

(1) Signal form and output phase

- 2-phase (A, B) pulse with 90° pulse difference
- Original point pulse (phase C)




Note: Phase C is synchronized with phase A.

Fig. 6.6

(2) Pulse resolution

The PG outputs 6000 pulses/rev. The pulse frequency can be further divided into 1/N (N=1 to 32) or 2/N (N=2 to 32), by using the divider in the servo driver. The phase relation is the same in (1), above.

The dividing ratio must be able to divide the pulses of the pulse generator. Table 6.7 shows dividing ratio and the number of pulses to be set after dividing. Setting is performed by user constant (Cn 18).

Table 6.5 PG Frequency Dividing Ratio and Numbers of Output Pulses

| Frequency Dividing Ratio | Output Pulses after Dividing | Frequency Dividing Ratio | Output Pulses after Dividing |
|---|---|---|---|
| 1/1 | 6000 pulses/rev | 1/8 | 750 pulses/rev |
| 2/3 | 4000 pulses/rev | 1/10 | 600 pulses/rev |
| 1/2 | 3000 pulses/rev | 1/12 | 500 pulses/rev |
| 2/5 | 2400 pulses/rev | 2/25 | 480 pulses/rev |
| 1/3 | 2000 pulses/rev | 1/15 | 400 pulses/rev |
| 1/4 | 1500 pulses/rev | 1/16 | 375 pulses/rev |
| 1/5 | 1200 pulses/rev | 1/20 | 300 pulses/rev |
| 1/6 | 1000 pulses/rev | 1/24 | 250 pulses/rev |
| 2/15 | 800 pulses/rev | 1/25 | 240 pulses/rev |
| | | 1/30 | 200 pulses/rev |

### 6.5.1 Incremental Encoder (Standard)(Cont'd)

(1) Output circuit and receiver circuit.

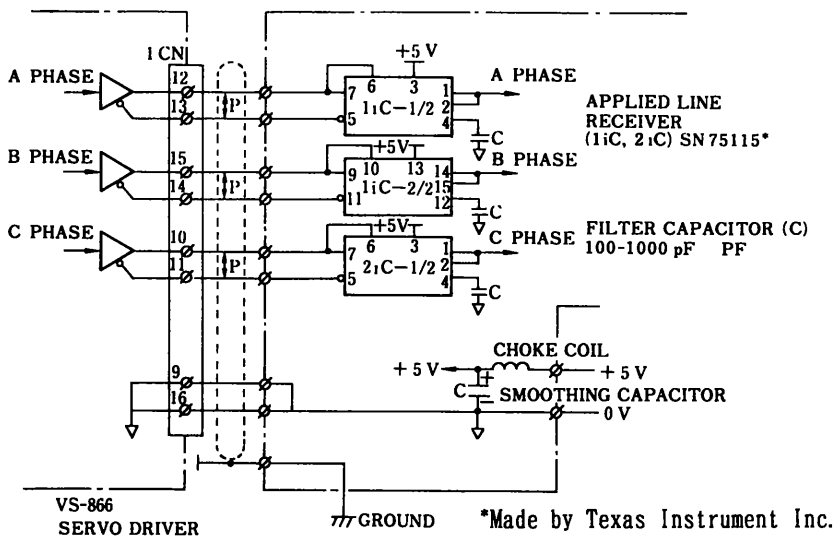



Fig. 6.7 Output Circuit and Receiver Circuit

### 6.5.2 Absolute Encoder

(1) Pulse output configuration

Fig. 6.1 shows the configuration of the absolute encoder pulse output circuit.

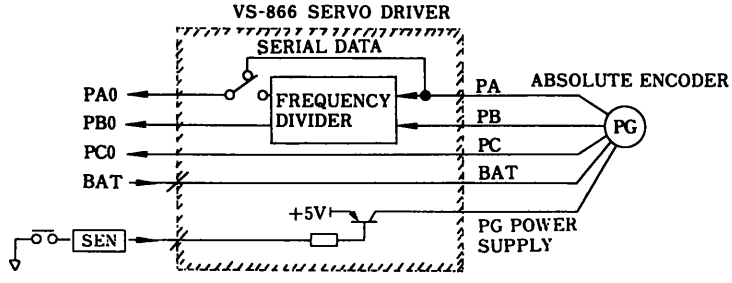



Fig. 6.8 Absolute Encoder Pulse Output

When SEN signal is input (closed contact), absolute data are first output from PA0 as serial data, then as initial incremental pulse PA0, PB0 (2-phase pules with 90-degree phase difference). After this, output operation similar to normal incremental encoder (2-phase pulse with 90-degree phase difference) is performed.

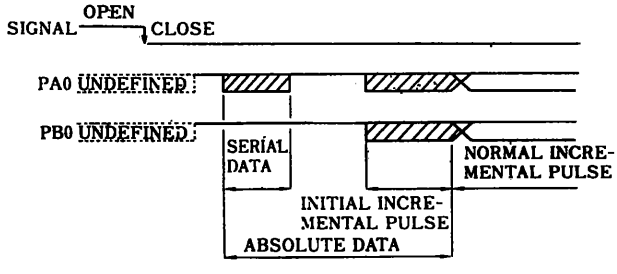



Fig. 6.9 Absolute Data Output

(2) Absolute data contents

• Serial data:

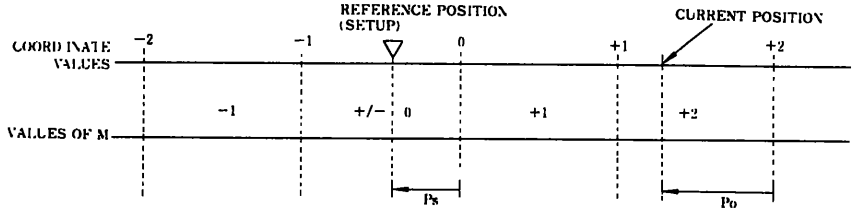
Indicates the position of the motor shaft (in terms of revolutions) from the reference position (value set at setup time).

• Initial incremental pulse:

Pulse is output at the same pulse speed as rotation is made at about 2747 rpm from the motor shaft origin position to the current motor shaft position.

Assuming that the serial data value is M (revolutions), the initial incremental pulse count value is Po (pulses), and the number of output pulses per revolution of the motor axis (depending on divider circuit setting) is R (pulses/rev) and initlal incremental pulse at reference position is Ps(pulse), the current position P can be found by the expression:

$$P_M = M \times R + P_O - P_S$$




$P_E$ : Current value read-out from encoder

M : Multirevolution data

$P_O$ : Initial incremental pulses read-out from encoder (Normally, negative value)

$P_S$ : Initial incremental pulses read-out at setup point (Normally, negative value.)

$P_M$ : Current value required in system

R : Number of pulses per encoder revolution (32768 pulses for this encoder)

$$P_F = M \times R + P_O$$

$$P_M = P_E - P_S$$

(3) Receiver circuit

Fig. 6.10 shows an example of an absolute encoder output processing circuit.

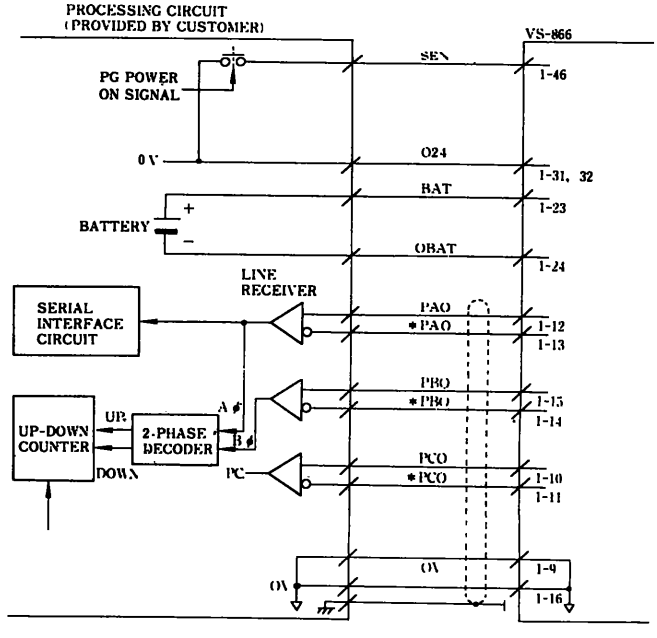



Fig. 6.10 Example of Output Processing Cricuit.

### 6.5.2 Absolute Encoder (Cont'd)

(4) Absolute data reception

Process absolute data in the following sequence:

Condition: sequence input [RDY] is open.

[SEN] signal is not accepted when [RDY] is closed.

① Switch on the [SEN] signal.

② After 100 ms, set serial data reception-waiting-state.

③ Clear the up-down counter for count incremental pulses.

④ Receive serial data of 8 bytes.

⑤ Normal incremental operation state is entered in approximate 50 ms after the last serial data is received.

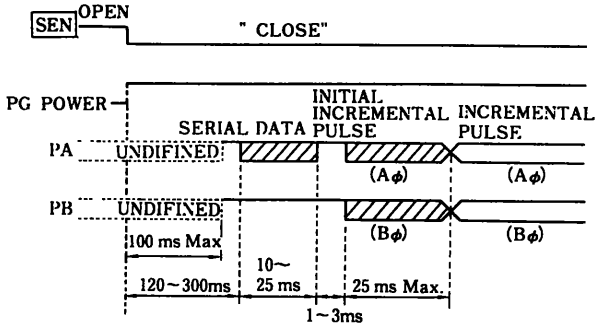


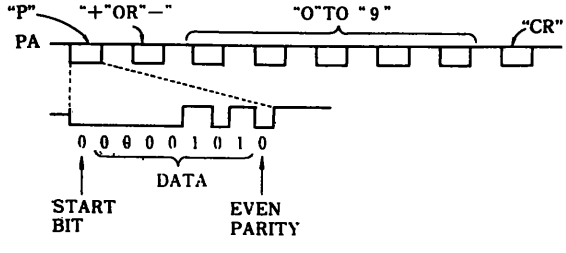

Fig. 6.11 Receive Processing of Absolute Data.

Cautions for [SEN] signal:

1. The [SEN] signal is part of the sequence input signals.
   Power is supplied to PG when the signal is switched on.
   Once the [SEN] signal is received, the [SEN] or [RDY] signal is not accepted(disregarded) until sending of the serial data initial incremental pulse is finished.
2. The [SEN] signal is not accepted if the encoder is in normal operation and the controller is operated. (The [SEN] signal is switched on to off or vice versa only during base blocking such as [RDY] switched off.)

(5) Serial data specifications

| Transmission Mode | Asynchronous(ASYNC) |
|---|---|
| Baud Rate | 9600 baud |
| Start Bit | 1 bit |
| Stop Bit | 1 bit |
| Parity | Even |
| Character Code | ASCII 7 bits |
| Data Format | 8 characters: (P)(+/-)(0 to 9)×5-digit (CR) |



① Serial data of 8 bytes (8 characters) is sent.

Format: P±XXXXX CR

Carriage Return Code

Digit from 0 to 9

② The serial data displays the number of revolutions from the reference point (set at setup time).

③ Zero rotation is represented by either P+00000 (CR) or P-00000 (CR).

④ For ±99999 revolutions or more, a correct value is not output.

(6) Incremental pulse

Initial incremental pulse giving absolute data and normal incremental pulse are output through the frequency divider. The frequency divider is set by using CN18.

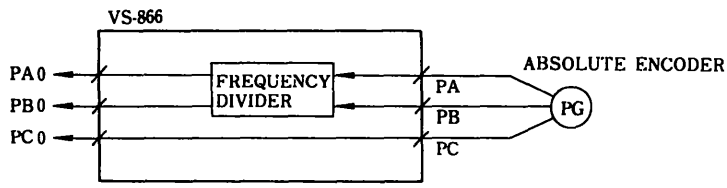
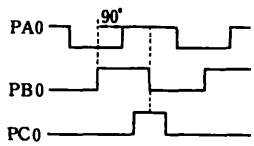



**Fig. 6.12 Incremental Pulses**

① Output Phase

• For foward running.




• For reverse running.

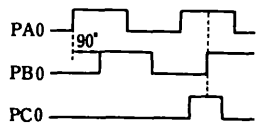
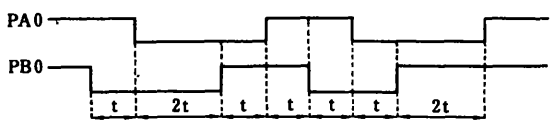



**Fig. 6.13 Forward/Reverse Output Phase**

PC0 (origin pulse) synchronizes with PA0, but the pulse width becomes narrow because PC0 is not divided. If the dividing ratio is not 1/2n, accurate 90-degree phase difference is not made and the pulses are output as shown in Fig. 6.14:




(The phase difference t, 2t part equally exists within one revolution, thus the minimum position error results.)

**Fig. 6.14 Freguency Dividing Ratio and Output Phase Difference**

### 6.5.2 Absolute Encoder (Cont'd)

② Frequency dividing setting

According to a required resolution, set the user constant (CN18PGRAT) to the number of pulses (N).

$$\text{Frequency dividing ratio} = \frac{\text{Number of pulses (N)}}{8192}$$

* Output frequency is N pulses/rotation.

(7) Absolute value encoder specification

Table 6.6 and Fig. 6.15 show the main specifications and block diagrams of the absolute-value encoder. The detection data are transmitted by combining serial data and two-phase pulses and are interfaced with the same number of signal lines as those of the incremental encoder.

**Table 6.6 Main Specifications of Absolute Encoder**

| | |
|---|---|
| Type | Pulse code with battery backup.<br>(Battery voltage 2.8-4.5V) |
| Number of Pulses | 8192 basic pulses/rev (× 4) |
| Maximum Speed | ±99999 rev |
| Data Transmission | Start up: serial data + initial incremental pulse |
| | Steady: incremental pulse, same as incremental encoder |
| Recommended Battery | Lithium cell ER6C made by Toshiba Battery |

Note: The absolute-value encoder battery has to be replaced periodically. A battery is estimated to have a life of 10 years. Refer to (9) in par. 6.5.2 for the method to replace the battery.

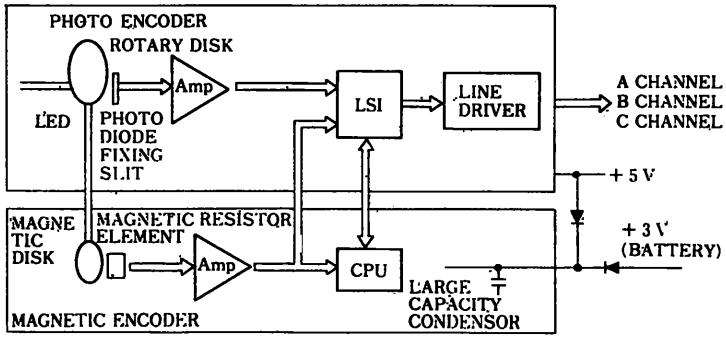



**Fig. 6.15 Block Diagram of Absolute Encoder**

(8) Setup method :

If revolution data is to be set to 0 at motor test run or the absolute encoder is not connected to the battery for more than four days, the following setup is required:(In the latter case, the internal elements may not operate normally because the encoder capacitor is discharged.) Perform the setup in numerical sequence. If this is not done, trouble may occur.

• How to set up (A)

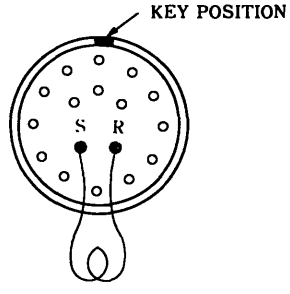
① Turn off VS-866 input power supply. Make sure the monitor panel display has disappeared.

② Remove PG cable between the encoder and control device.

③ Short circuit across R and S pins of the encoder connector for 2 minutes or more to discharge the encoder capacitor charge.

④ Wire the cable normally connect the battery to the encoder.

⑤ Turn on the control device, output [SEN] signal and perform absolute data reception. If absolute error " APS " is displayed on the monitor panel, start again from ①.




• How to set up (B)

① Turn off VS-866 input power supply.

② As shown in Fig. 6.16, remove 2CN of control device and short circuit across PG cable by the control device connector for 2 minutes or more.

④ to ⑤ Same as (A).

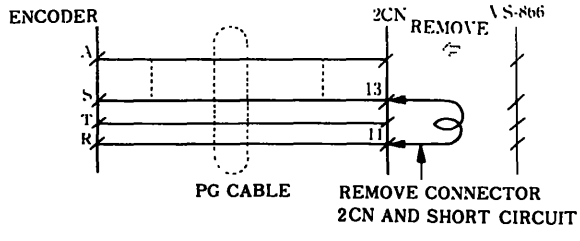



**Fig. 6.16 How to Set up by PG Cable**

(9) How to replace battery :

Follow the procedures below to replace the battery (prepared by user) for absolute encoder. A lithium cell ER6C has a life of approximately 10 years.

① Turn on the servo driver, close [SEN] signal and wait for more than 3 minutes. Keep [RDY] closed. The encoder capacitor will be charged.

② Replace the battery. The servo driver may be left on or off.

Thus the battery can be replaced without destroying rotation data of the encoder.

〔The encoder functions properly for 4 days after performing① (without battery).〕

(10) Battery module

The absolute encoder has to detect motor rotation even when power supply is off. The encoder is backed-up by a large capacitor ; however, it should be backed-up by a battery as well. Therefore, the battery module (JEPMC-2010) with a lithium cell, voltage drop detection circuit, LED for voltage drop information, and I/O function are prepared.

The battery module checks the battery voltage at 5V power supply on and detects the alarm of voltage drop according to the absolute encoder specification.

When the battery module detects the alarm, the encoder externally outputs an alarm signal as I/O signal and lights the alarm LED on the module.

After alarm detection, replace the battery within 3 weeks.

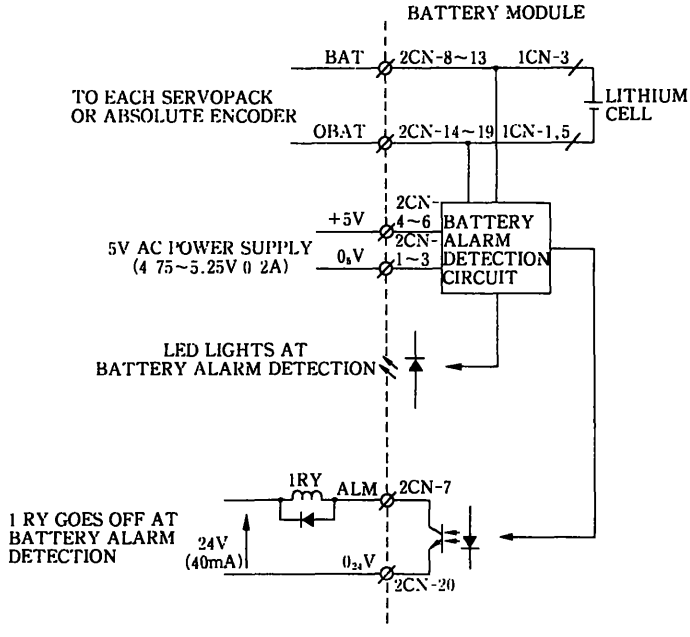


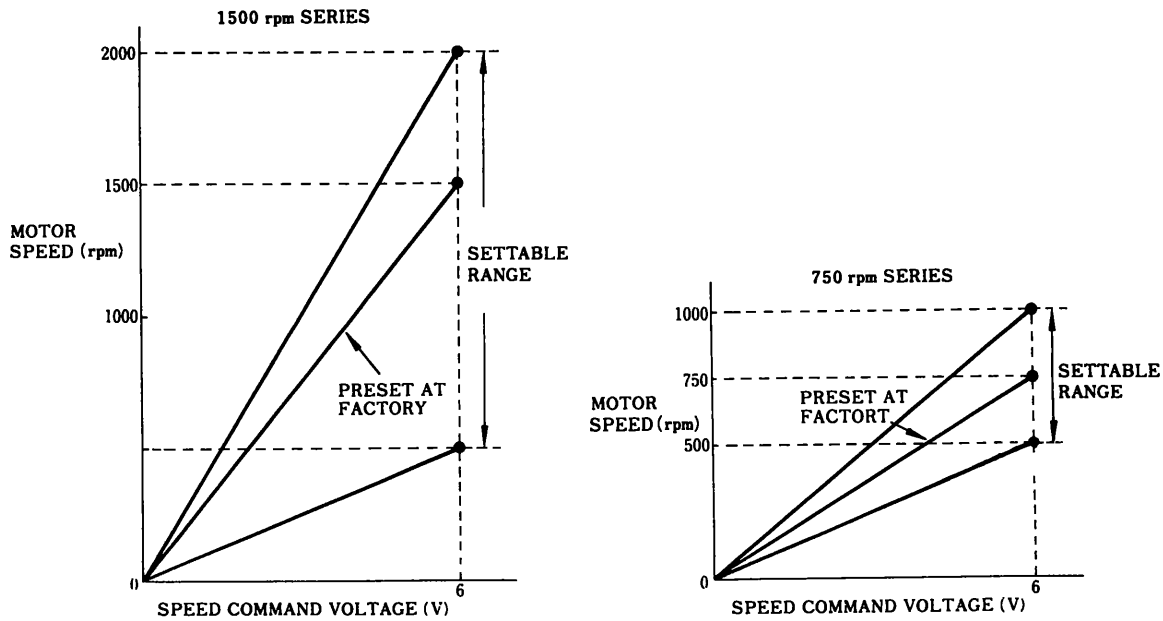

**Fig 6.17 Battery Module Signal Circuitry**

# 7. USER CONSTANTS

VS-866 (servo driver) has the following user constants allowing settings and changes in accordance with the system. Use these constants after understanding the in meanings.
Setting and changes can be performed on the monitor panel. (Refer to sect. 9. "MONITOR PANEL OPERATION.")

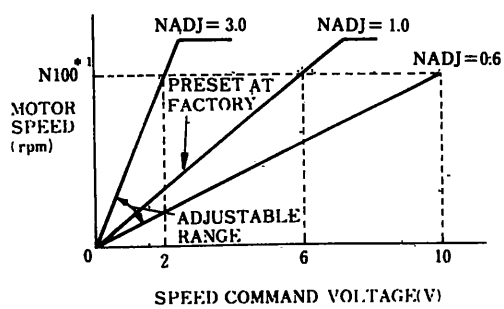
(1) Rated speed: C n 0 1 (N100). "Cn" is the abbreviation of Constant Number.

- Set the motor speed when the speed reference voltage (1CN between 3 and 4) is 6V. *
  * 10V can be selected by setting a select/set constant.
- The settable range is 500 to 2000 rpm for the 1500 rpm series and 500 to 1000 rpm for the 750 rpm series.
- 1500 and 750 rpm are preset for the 1500 and 750 rpm series at the factory prior to shipment.




(2) Speed reference adjustment gain: C n 0 2 (NADJ)

- This is a adjustment constant of the motor spped. The adjustable range is 0.6000 to 3.0000.
- For position control, the set value is larger, the position loop gain is higher.
- 1.0 is preset at the factory prior to shipment.




*N100: Set value of Cn01 (rpm)

(3) Speed zero adjustment: Cn03 (NOFS)

- This constant is for speed reference offset voltage adjustment. Adjust in accordance with sect. 11, "TEST RUN."
- The adjustable range is -0.9 to +0.9V. (Set value: F488 to BB8)
- 0 has been preset at the factory prior to shipment.

(4) Speed controller constant: Cn04 to Cn11 (PASR1, TASR1, ···, PASR4, TASR4)

- Constants for the proportional gain (PASR) and integration time (TASR) for the speed controller (proportion-integration operation).
- Four sets of proportional gains and integration constants are preset in VS-866. Select an optimal setting by the sequence signals ASR0 (1CN-41) and ASR1 (1CN-42) in accordance with the load specifications. Table 7.1 shows the criteria for selection of the speed controller constants.

**Table 7.1 Speed Controller Constants**

| | Speed Controller Constant Select Signal | | Speed Controller Constant *2 | |
|---|---|---|---|---|
| $J_L/J_M$ *1 | ASR0(1CN-41) | ASR1(1CN-42) | Proportional gain | Integral time |
| 0.5 to 2.0 | Open | Open | PASR1; Cn04(20) | TASR1; Cn05(50msec) |
| 2.0 to 4.0 | Closed | Open | PASR2; Cn06(40) | TASR2; Cn07(50msec) |
| 4.0 to 7.0 | Open | Closed | PASR3; Cn08(60) | TASR3; Cn09(50msec) |
| 7.0 or more | Closed | Closed | PASR4; Cn10(110) | TASR4; Cn11(50msec) |

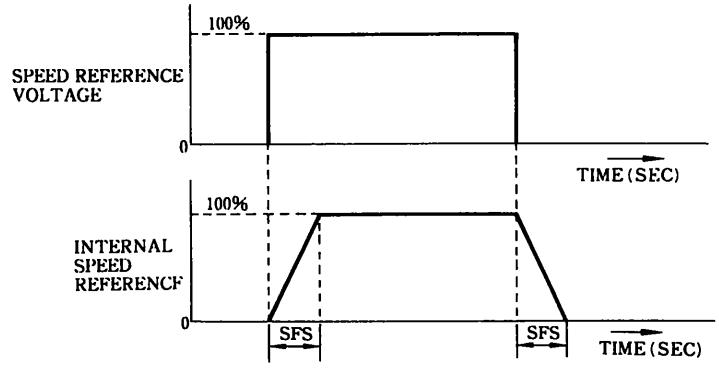
*1 $J_L$ Moment of load inertia (kg • cm², lb • in • s² × $10^{-3}$)
$J_M$ Moment of motor inertia ( kg • cm², lb • in • s² × $10^{-3}$)
*2 Factory set value in (parentheses.)

- Switch off ASR0 and ASR1 and set Cn04 at 10 if $GD^2_L$ = 0 when operating the motor without a load ($J_L$ = 0).
- Settings of the constants can be changed using the monitor panel.
- The adaptability increases as the proportional gain becomes higher. However, if the proportional gain is too high, overspeed results and response becomes unstable.
  The system becomes more stabilized as the integration time constant becomes longer, even though the response to load disturbance may delay the integration time.

(5) Soft starter time: Cn12 (SFS)

- This is the time setting until the internal speed reference reaches from 0 rpm to the rated speed or vice versa.
- The settable range is 0.000 to 10.000sec; 0.000sec has been preset at the factory prior to shipment.
- Set to 0.000 during position control.

## 7. USER CONSTANTS (Cont'd)




(6) Zero-speed level: Cn13 (ZSP)

- This is the set constant for the motor zero-speed decision level. (The set value is set by % for rated speed Cn01.)
- If the motor speed (feedback value) falls below this set value, the sequence output ZSPD switches on (1CN between 27 and 31: conducted).
- Note that coasting may be caused if the motor speed falls below this set value in an emergency stop.
- The settable range is 0.0 to 20.0% and 2.0% has been preset at the factory prior to shipment.

(7) Speed monitor adjustment gain: Cn14 (SMADJ)

- This is the adjustment gain constant of the speed monitor (1CN 19-20) output voltage.
- The adjustable range is 0.9 to 1.1. 1.0 has been preset at the factory prior to shipment.
- If the set value is 1.0, ±6V/±rated speed (+ for forward revolutions, - for reverse revolutions) will result.

(8) Torque meter adjustment gain: Cn15 (TMADJ)

- This is the adjustment gain constant of the torque monitor (1CN 21-22) output voltage.
- The adjustable range is 0.9 to 1.1. 1.0 has been preset at the factory.
- If the set value is 1.0, ±3V/± rated torque (+ for forward side and - for reverse side) will result.

(9) $J_L$ : Cn16 ($GD^2$)

- Setting is not necessary.

(10) Emergency stop torque: Cn17 (TEMG)

- Braking torque in an emergency stop is set. (The set value is % of the motor rated torque.)
- Braking is performed in accordance with this set torque to stop the machine if sequence input EMG (1CN 37-31) is switched off or if the emergency stop mode activates due to a power failure or for other reasons.
- The settable range is 0 to 350%. However, recommended setting is 100 to 200%.
- 100% is preset at the factory prior to shipment.

(11) PG dividing ratio: Cn18 (PGRAT)

- Detected pulses (Pulses A and B) from the PG (pulse generator) are divided by the dividing ratio set in this section and are output to 1CN 12 to 14.
- The set values are different for the incremental encoder (standard) and absolute value encoder (optional).

Incremental encoder

Dividing ratio 1/N : Set the value of N. (N: 1 to 32)

Dividing ratio 2/N : Set "2" in the highest digit and set the value of N. (N:2 to 32)

Example: 1/5 division. Set value 00005

2/5 division. Set value 20005

Absolute value encoder

Dividing ratio N/8192: Set the value of N. (N:2 to 8192)

(12) Voltage adjustment: Cn19 (VADJ)

- This is the constant needed to make fine adjustment of the excitation current of the motor to be coupled and to adjust to the required voltage (no-load voltage).
- Set in accordance with sect.11, "TEST RUN."
- The settable range is 0.8 to 1.2. 1.0 is preset at the factory prior to shipment.

(13) Ambient temperature: Cn20 (TEMP)

- The servo motor ambient temperature is set. Do not attempt to adjust except ultra precision torque control.
- The settable range is -10 to +60℃. 20℃ is preset at the factory prior to shipment.

(14) ASR output filter: Cn21 (DTL)

- This is the filter constant of the speed controller output.
- Used only if there is excessive play in the mechanical system and the proportional gain of the speed controller cannot be increased to a high value.
- Normally set to 1.0msec.
- The settable range is 1.0 to 20.0msec. 1.0msec is preset at the factory prior to shipment.

(15) Forward-side torque limit: Cn22 (TLF)

- This is the limit value for motor forward revolution torque.
- Other torque limit of 200% is set internally. If set higher than 200%, the limit value will be 200 %.
- The settable range is 0.0 to 350.0%. 350.0% is preset at the factory prior to shipment.

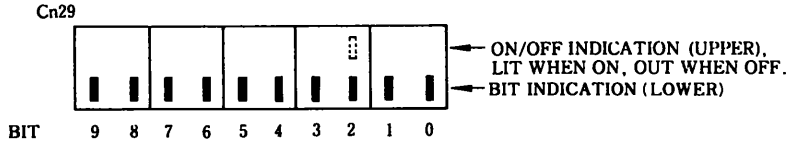
(16) Reverse-side torque limit: Cn23 (TLR)

- This is the limit value for motor reverse revolution torque.
- Other torque limit of 200% is set internally. If set higher than 200%, the limit value will be 200%.
- The settable range is 0.0 to 350.0%. 350.0% is preset at the factory prior to shipment.

## 7. USER CONSTANTS (Cont'd)

(17) Selecting/setting constant 1: Cn29 (SELCD1)

• This constant selects and sets the operation mode. (Bit setting)



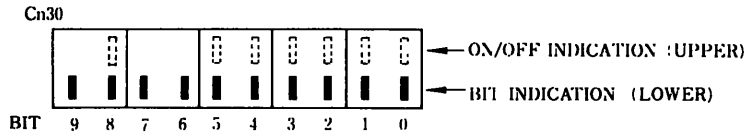

[ ]:Standard factory-adjusted setting

| Bit | Abbreviation | Name | Setting | |
|---|---|---|---|---|
| | | | OFF | ON |
| 0 | SETRW | Setting-constant setting | Setting/reference disable | Setting/reference enable |
| 1 | OTSEL | Overtravel selecting | Without overtravel | With overtrevel |
| 2 | LOCL/REM | Local/Remote | Remote (External reference) | Local (Monitor panel) |
| 3 | NLIMREV | Speed limit polarity | Plus voltage valid | Minus voltage invalid |
| 4 | PTQLREV | Forward torque limit polarity | Plus voltage valid | Minus voltage invalid |
| 5 | TLQSEL | Output during torque limit | Disable | Enable |
| 6 | UCNSEL | Constant change during operation | Disable | Enable |
| 7 | PREF | RS-232C communication mode selection | — | Do not set to ON. |
| 8 | PASOCN1 | | — | |
| 9 | PASOCN2 | | — | |

Note: See par. 8 "SYSTEM DESIGN PRECAUTIONS" for details and operating method.

(18) Selecting/setting constant 2: Cn30 (SELCD2)

• This constant selects the control mode, reference input level and others. (Bit setting)




□ :Standard factory-adjusted setting

| Bit | Abbreviation | Name | Setting | |
|---|---|---|---|---|
| | | | OFF | ON |
| 0 | TQCM | Torque control mode | Setting/reference disable | Setting/reference enable |
| 1 | SPDSEL | Speed reference voltage | 6V/100% | 10V/100% |
| 2 | TRQSEL | Torque reference voltage | 3V/100% | 6V/100% |
| 3 | 2CH-AD | 1CN-5 input | Enable | Disable |
| 4 | 3CH-AD | 1CN-7 input | Enable | Disable |
| 5 | DLMT | Speed limit function | Single side | Both side |
| 6 | FNFSEL | Field forcing | Enable | Do not set to ON. |
| 7 | IPPI | – | – | |
| 8 | REVSEL | Rotating-direction selecting | Clockwise rotation* at FWD-run reference pulses | Counterclockwise rotation at FWD-run reference pulses |
| 9 | PGNEG | PG disconnection detection | Enable | Disable |

*When viewed from the drive end

Note: See par.8 "SYSTEM DESIGN PRECAUTIONS" for details and operating method.

## 8. SYSTEM DESIGN PRECAUTIONS

Pay attention to the following items when designing the operation sequence of VS-866.

(1) Set up a sequence that will switch off the magnetic contactor (MC) on the input side of the power unit if the thermal relay for protection of the braking resistors trips. (To prevent burning of braking resistors.)

(2) The motor sets to a coasting state if [RDY] is switched off during operation.
Note: Braking stop in the event of a power failure:
Operate the sequential power (24 VDC) back-up and delay release relay so that [RDY] does not switch off more than 1sec, after a power failure. If [RDY] switches off before stopping, the motor sets to a coasting stop at this time.

(3) Dispersion of reference and mode switching timing
The dispersions of timing at which the internal value of VS-866 actually changes to fluctuations of the external reference voltage (speed and torque references) or control mode select input TSEL are less than 2msec. Eliminate select time dispersions as follows if dispersions are not desiredbecause of special applications.
Step 1 : Switch on [INH]. (Reference reading will be prohibited.)
Step 2 : Change the reference voltage or [TSEL].
Step 3 : Switch on [SYNC] and then switch it off again.
Step 4 : Reset [INH] to off.
By switching the reference and control modes by these steps, the reference is read within 2msec after switching on [SYNC] and dispersions of select timing can be eliminated almost entirely.

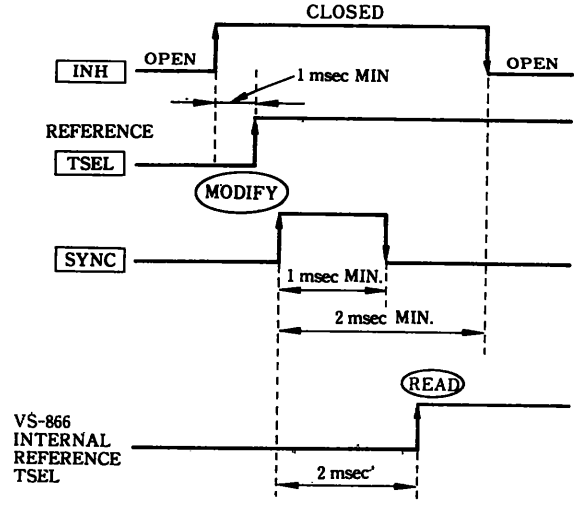
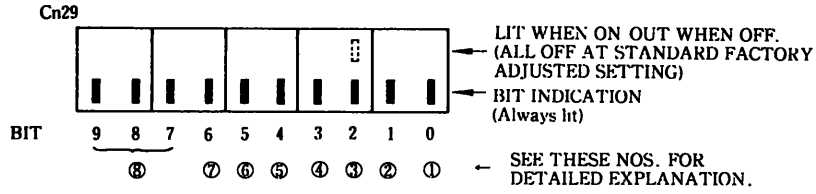



Fig. 8.1 Time Chart

(4) Selecting/Setting constant 1: Cn29 (SELCD1)




① Bit 0: SETRW  [ ] : Standard factory-adjusted setting

| | |
|---|---|
| OFF | Setting-constant setting/reference enable |
| ON | Setting-constant setting/reference disable |

↑
Set to ON when setting-constant (Cn31 to Cn50) setting is changed.
Normally, do not attempt to adjust.

② Bit 1: OTSEL (Usable for P-ROM No. NSJ000110 and beyond)

| | |
|---|---|
| OFF | Without overtravel (P-OT, N-OT) |
| ON | With overtravel |

↑
Set to ON when forward/reverse running inhibit (P-OT/N-OT) by external sequence input is used. Open the P-OT/N-OT. For details, see the following "Forward/reverse Running Inhibit (P-OT/N-OT) Control Mode."

Note: The functions INH (reference input stop) and LOW (constant-speed winding selection) are not performed. For detailed, see "Forward/reverse Running Inhibit (P-OT/N-OT)" on the next page.

| | Cn29 Bit 1 | |
|---|---|---|
| | OFF | ON |
| 1CN-44 | INH | P-OT |
| 1CN-36 | LOW | N-OT |

## 8. SYSTEM DESIGN PRECAUTIONS (Cont'd)

• Forward/reverse Running Inhibit (P-OT/N-OT)

Control Mode: Speed Control I or II

These modes are used when linear operation is not required to advance beyond a position.

<Setting> Set bit 1 on Cn29 to ON.

<Result> The functions of sequence input [INH] and [LOW] (1CN-44, 36) are changed as follows.

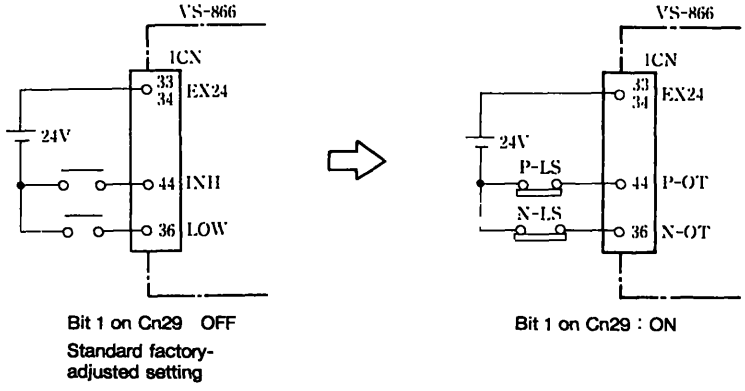



Fig. 8.2 Circuit Diagram of 1CN-44 and-36

- Forward-running inhibit at P-LS opening, and reverse-running inhibit at N-LS opening.
- At P-LS or N-LS opening, VS-866 stops after deceleration. The braking torque is normal torque limit value (external torque limit reference or internal torque limit setting value).
- At P-LS opening: FWD-run reference not accepted.
  RVS-run reference accepted.
  At N-LS opening: FWD-run reference accepted.
  RVS-run reference not accepted.
  At both openings: Zero-speed control is executed without regard to reference voltage.

Note:

1. The forward (reverse) run means counterclockwise (clockwise) rotation when viewed from the drive end without regard to ON/OFF of bit 8 on Cn30.
2. These modes are also effective at torque control. The braking torque at P-LS and N-LS opening is fixed (200%) and not changed in this status.

③ Bit 2: LOCL/REM

| | |
|---|---|
| OFF | Remote (External reference operation) selection |
| ON | Local (Monitor panel operation) selection |

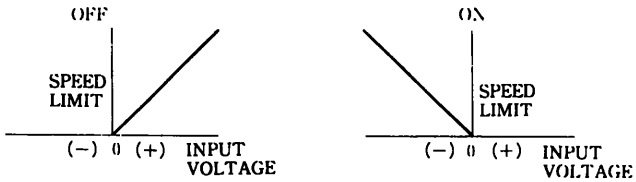
↑
Set to ON when the motor is run at monitor panel operation during test run, etc. Speed reference and RUN/STOP operation can be input from monitor panel.

Note: Be sure to close the external sequence input [RDY] and [EMG], because these inputs are effective even with local mode selection.

④ Bit 3: NLIMREV (Usable for P-ROM No. NS J000110 and beyond)

| | |
|---|---|
| OFF | Speed limit input, plus voltage valid |
| ON | Speed limit input, minus voltage valid |

↑
Set to ON when speed limit input voltage is used at minus voltage during torque control.




Note: This setting is invalid for speed control.

⑤ Bit 4: PTQLREV (Usable for P-ROM No. NSJ000110 and beyond)

| | |
|---|---|
| OFF | Forward-side torque limit input, minus voltage valid |
| ON | Forward-side torque limit input, plus voltage valid |

⑥ Bit 5: TLQSEL (Usable for P-ROM No. NSJ000110 and beyond)

| | |
|---|---|
| OFF | Sequence output able during torque limit |
| ON | Sequence output disable during torque limit |

↑
Set to ON when sequence output signal is required during torque limit.

The sequence output (1CN-30) is turned on while torque is limited by external torque limit input or internal torque limit setting value (Cn22, Cn23).

Note: When this bit is turned on, the content of 1CN-30 signal is changed.

| | Bit 5 | |
|---|---|---|
| | OFF | ON |
| 1CN-30 | HI/LO | TLQSEL |

↑
Switching answer signal
for using winding switch unit (option)

⑦ Bit 6: UCNSEL (Usable for P-ROM No. NSJ000110 and beyond)

| | |
|---|---|
| OFF | User constant can be changed during operation |
| ON | User constant can not be changed during operation |

↑
Set to ON when positioning loop gain (Kp) is adjusted by using Cn02 at test-run of positioning control. The constant can be changed even during motor operation.

Note: After adjusting, be sure to turn it OFF.
Do not change other constants during motor operation.
For details, see the following "Adjusting of Positioning Loop Gain (kp) "

## 8. SYSTEM DESIGN PRECAUTIONS (Cont'd)

• Adjusting of Positioning Loop Gain (kp)

This adjustment is performed for the most suitable positioning control by combining positioning unit (e.g. position pack).

| | |
|---|---|
| Adjusting constant | User constant Cn20 (NADJ) |
| Adjusting method | Adjust in combination with servomotor and driven machine. |

(a) Connect oscilloscope or scale scope to the 1CN 19㊐-20㊍ of Servo driver or check terminal [SM] – [GND] of control card. (speed monitor)

(b) After turning on the START signal of positioning unit, operates the motor and monitors speed monitor waveform.

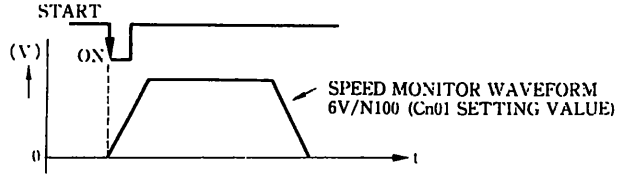
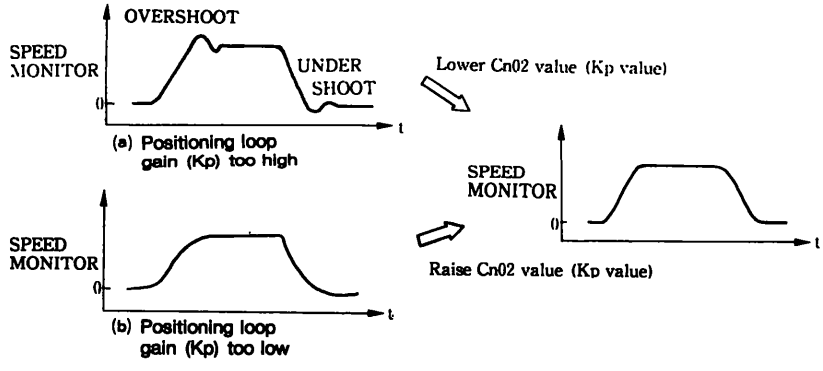



Fig. 8.3 Speed Monitor Waveform

(c) The standard factory-adjusted setting of Cn02 is 1.0000 and the adjustable range is 0.6000 to 3.0000.

If the leading edge or trailing edge in speed monitor waveform overshoot or undershoot, lower the setting value of user constant Cn02 (NADJ).



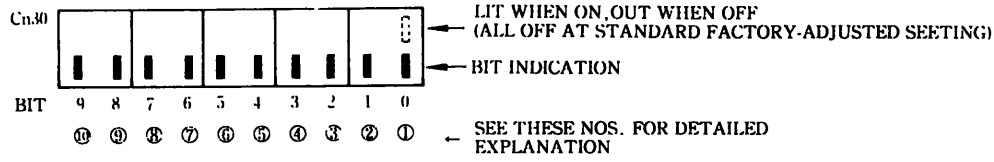

Note: Cn02 value can be changed only when the sequence input [RUN] is opening. However, for P-ROM No. NSJ000110 and beyond, Cn02 value can also be changed during operation by turning on bit 6 of Cn29.

Fig. 8.4 Speed Monitor Waveform

⑧ Bits 7 to 9: PREF, PASOCN1, PASOCN 2

These bits are used to select RS-232C communication mode for delivery inspection. Do not tamper with these bits.

(5) Selecting/setting constant 2: Cn30 (SELCD 2)




① Bit 0: TQCM ☐: Standard factory-adjusted setting

| | |
|---|---|
| OFF | Speed control I |
| ON | Torque control, Speed control II |

Set to ON when torque control is used (including switching speed control and torque control during operation).

② Bit 1: SPDSEL

| | |
|---|---|
| OFF | 6V/rated speed |
| ON | 10V/rated speed |

Set to ON when speed-reference voltage level is required: 10V/rated speed.

③ Bit 2: TQRSEL

| | |
|---|---|
| OFF | 6V/rated speed |
| ON | 10V/rated speed |

Set to ON when torque-reference voltage level is required: 6V/rated torque.

④ Bit 3: 2CH-AD (Usable only for speed control I)

| | |
|---|---|
| OFF | Forward torque limit input is not used. |
| ON | Forward torque limit input is used. |

- At speed control:

  Set to ON when forward torque limit input is not used (not connected) in speed control. Internal torque limit is 200%. If it is set at 200% or below, set limit value (%) to Cn22.

- At torque control:

  Torque reference is acceptted without regard to ON/OFF of this bit.

## 8. SYSTEM DESIGN PRECAUTIONS (Cont'd)

⑤ Bit 4: 3CH-AD (Usable for speed control I and II)

| | |
|---|---|
| OFF | Reverse torque limit, RVS/FWD torque limit input is used. |
| ON | Reverse torque limit, RVS/FWD torque limit input is not used. |

↑

- At speed control I:

  Set to ON when reverse torque limit is not used. The internal torque limit is 200%. If it is set at 200% or below, set limit value (%) to $C n 23$.

- At speed control II:

  Set to ON when RVS/FWD torque limit is not used. The internal torque limit is 200%. If it is set at 200% or below, set forward torque limit to $C n 22$ and reverse and reverse torque limit to $C n 23$

⑥ Bit 5: DLMT (at speed control)

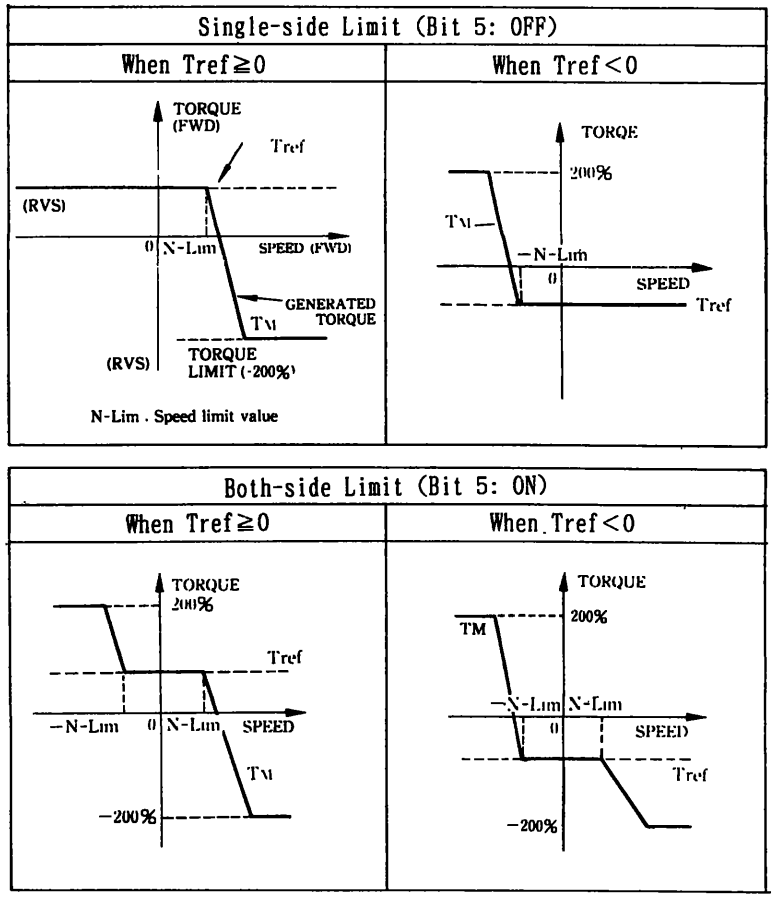
| | |
|---|---|
| OFF | Torque reference direction* limit |
| ON | FWD/RVS direction limit |

↑

- At torque control:

  Normally speed control is only torque reference direction* because of overrun protection. Set to ON for FWD/RVS direction limit operation.

  *The motor rotates counterclockwise (when viewed from the drive end) by plus torque reference and rotates clockwise by minus torque reference.



⑦ Bit 6: FNFSEL

| | |
|---|---|
| OFF | Field forcing enable |
| ON | Field forcing disable |

↑
Normally, this bit should be kept OFF.

VS-866 is executing field forcing because of shorting motor-flux form time at initial excitation ( RDY ⇨ ON). If bit 6 is turned ON, field forcing is not executed.

⑧ Bit 7: IPPI

Do not tamper with this bit.

⑨ Bit 8: REVSEL

| | | |
|---|---|---|
| OFF | Counterclockwise* rotation at plus speed reference voltage | *when viewed from the drive end |
| ON | Clockwise rotation* at plus speed reference voltage | |

↑
Set to ON for changing the motor rotation direction. The output pulse phase from VS-866 after executing PG pulse dividing determined by motor rotating direction.

⑩ Bit 9: PGNEG

| | |
|---|---|
| OFF | PG disconnection detection able |
| ON | PG disconnection detection disable |

↑
Set to ON when PG disconnection detection is not executed such as mechanical stop by stopper. Normally, this bit should be kept OFF.

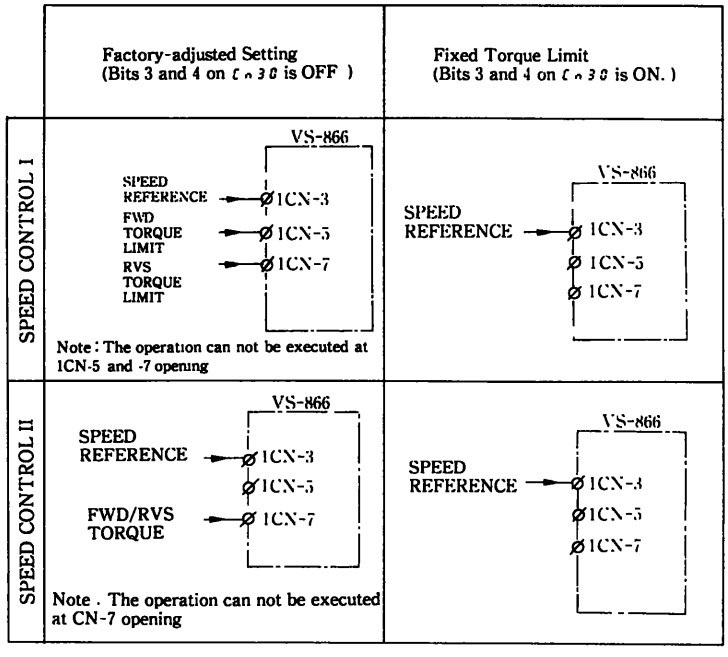
## 8. SYSTEM DESIGN PRECAUTIONS (Cont'd)

(6) Selecting when external torque limit input is not used

When VS-866 is used at speed control mode and torque limit signal (1CN-5, 7) is not input (connected):

<Setting> Set bits 3 and 4 on Cn30 to ON.

<Result> VS-866 can be used without external torque limit at fixed torque limit on speed control. Torque limit value of FWD/RVS side becomes 200% of rated torque (50%ED). If it is set at 200% or below, set the data to Cn23 or Cn24.




Note:

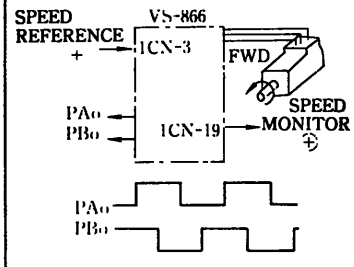
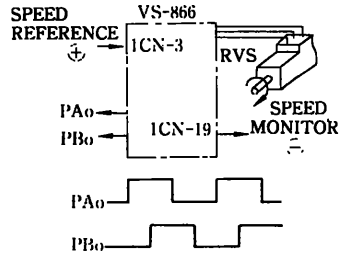
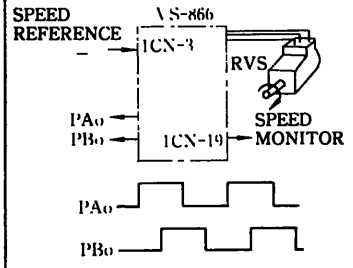
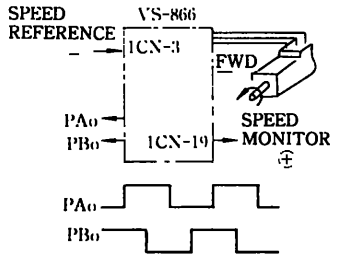
1. If the external torque limit is not input, when bits 3 and 4 on Cn30 remain OFF; the VS-866 can not be operated. In this case, the torque limit reference is regarded as 0%,
2. For torque control, bits 3 and 4 setting on Cn30 are irrelevant to the VS-866 operation.

(7) Setting of motor reverse running.

This is set when the relationship between speed reference polarity (plus/minus) and motor running direction (FWD/RVS) are changed.

<Setting> Set bit 8 on Cn30 to ON.

<Explanation> See table below.

| Reference | Factory-adjusted Setting (Bit 8 on Cn 30 is OFF.) | Reverse-running Setting (Bit 8 on Cn 30 is ON.) |
|---|---|---|
| Plus (+) |  |  |
| Minus (−) |  |  |

Note:

1. These settings are effective only at speed controls I and II.
2. For torque control, the speed limit direction is not changed.
3. The connection need not be changed.
   However, if Yaskawa Servopack (synchronous motor) is connected at reverse-running setting, phases $PA_0$ and $PB_0$ differ. To make the same phases as in the Table above, reverse the connections of $PB_0$ and $*PB_0$.
4. For using the absolute encoder, normal incremental pulse and initial incremental pulse in absolute data are output in the direction opposite to the normal direction. However, serial data code in the absolute data are not reversed. Therefore, use reversed serial data code when making the opposite direction connection.

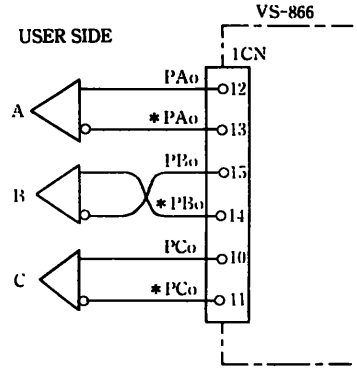



Fig. 8.5

# 8. SYSTEM DESIGN PRECAUTIONS (Cont'd)

(8) Motor zero-speed control

This function is used to keep stop status of the motor at speed control (P-I control).

To stop the motor, set the reference voltage to 0V at speed control.

For analog input, it is difficult to keep 0V perfectly. The motor may rotate if it remains at 0V setting. To prevent motor rotation, execute the following way.

① Open sequence input [RUN]:

Torque will not be generated to disturb the load.

② Close sequence input [IRST] to switch speed control to the P-control:

The speed regulation becomes large and causes load disturbance. See figure below.

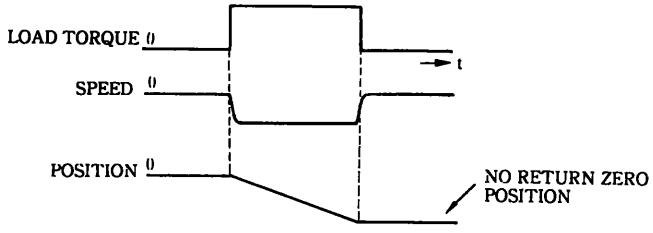


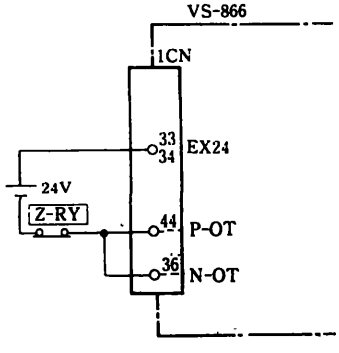

Fig. 8.6 Speed Response for Load Disturbance at P control

(P-ROM No. NSJ000110 and beyond)

VS-866 can be zero-speed control by switching sequence input.

<Setting> Set bit 1 (Second from right) on Cn29 to ON.

<Result> The functions of 1CN-44 (INH) and 1CN-36 (LOW) are changed.




| | Bit 1 on Cn29 | | | |
|---|---|---|---|---|
| | OFF* ⇨ | | ON* | |
| 1CN-44 | INH | Reference read-in stop | P-OT | Forward-running prohibit at open |
| 1CN-36 | LOW | Low-speed winding selection | N-OT | Reverse-running prohibit at open |

Fig. 8.7

- Be sure to close [Z-RY] to rotate the motor.
- When [Z-RY] becomes open, internal speed reference is set at 0 without regard to the external speed reference input.
- If [Z-RY] becomes open during operation, the motor becomes zero-speed control after stopping.
- Soft starter does not function.
- The motor never rotates by drift even if speed control remains PI control ([IRST] opening). See Fig. 8.8.

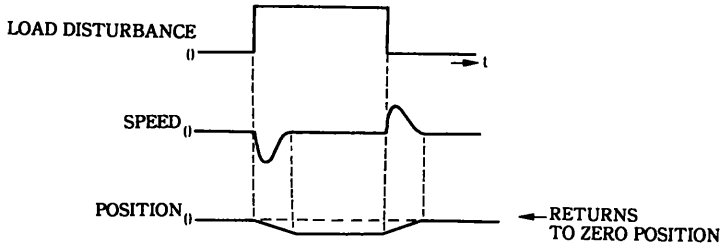



Fig. 8.8 Speed Response for Load Disturbance at P-I Control

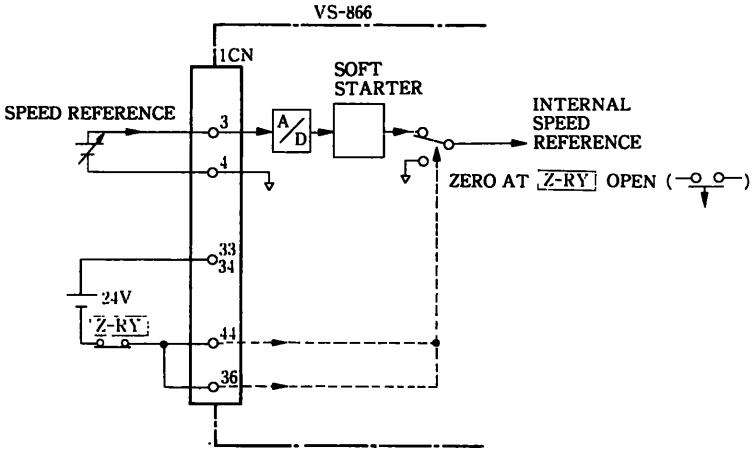
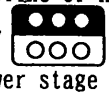


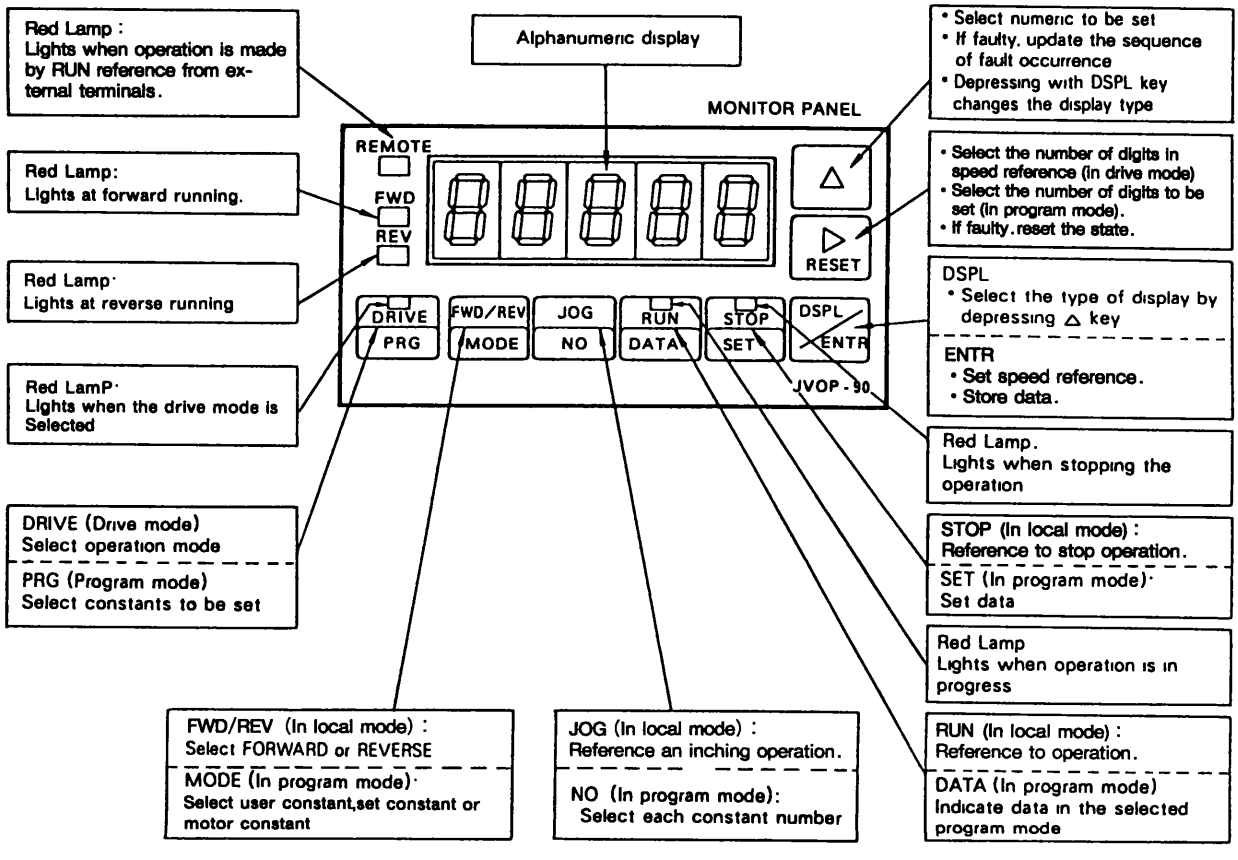

Fig. 8.9

# 9. MONITOR PANEL OPERATION

## 9.1 KEY FUNCTIONS

• Outline of key functions.

Key  functions as explained in the upper stage when a drive mode is selected and in the lower stage when a program mode is selected.




• Constant setting data on the monitor panel remain conserved even when power is turned off.

• Details of an error are stored even when power is turned off and can be checked after turning on the power.

• Monitor mode can be changed during operation.

• Program mode can be changed at stopping.

Note: In case of remote drive mode, this panel is used for displaying variables.

## 9.2 MONITOR PANEL FUNCTIONS.

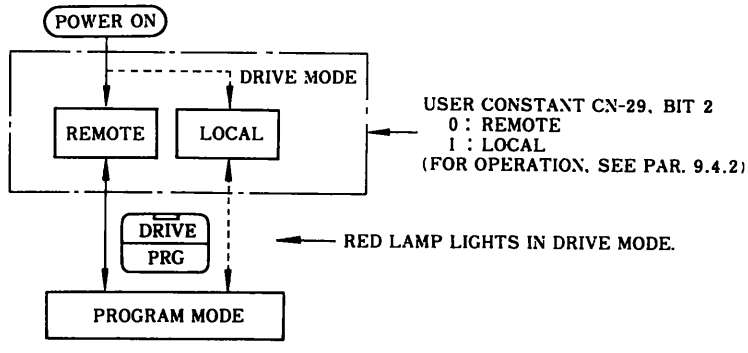
Table 9.1 shows monitor panel functions.

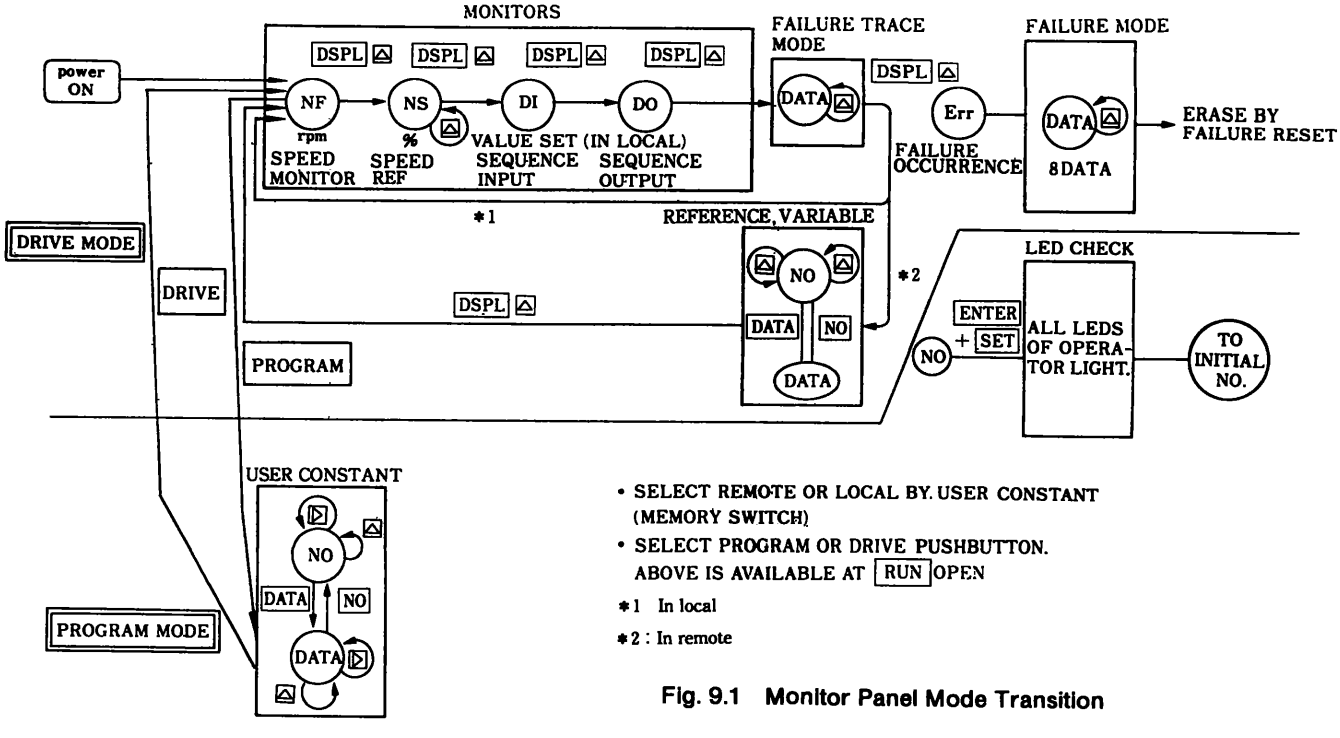
**Table 9.1 Monitor Panel Functions**

| Mode | | | Description | |
|---|---|---|---|---|
| Drive Mode | Remote | Normal operation (by external terminal reference) | Reference and variable displayed | • Monitors for speed, speed reference, sequence input, sequence output<br>• Failure display<br>• Failure trace* |
| | Local | Test run (by reference on monitor panel) | Speed reference setting, run operation on monitor panel | |
| Program Mode | | Setting and display of constants | Setting and display of constants | |

* Trace of failure occurrence before power failure

When the control power is turned on, a drive mode (remote or local) is posted. Remote or local is selected by user constant (Cn-29).
Fig. 9.1 shows a mode transition diagram for the monitor panel.




- SELECT REMOTE OR LOCAL BY USER CONSTANT (MEMORY SWITCH)
- SELECT PROGRAM OR DRIVE PUSHBUTTON. ABOVE IS AVAILABLE AT RUN OPEN

*1 In local

*2 : In remote

**Fig. 9.1 Monitor Panel Mode Transition**

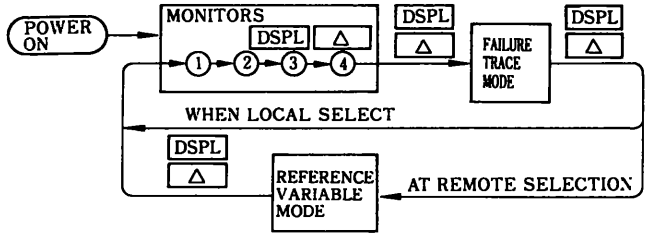
## 9.3 DRIVE MODE

### 9.3.1 Monitors

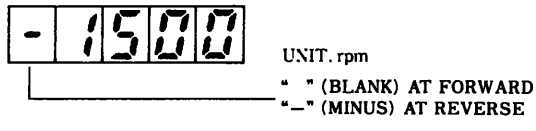
The speed, speed reference and I/O signals are monitored by use of the monitor panel. When in the local mode, the speed reference can be set.

| | Monitor Type | Description |
|---|---|---|
| 1 | Speed monitor | Displays motor speed in rpm |
| 2 | Speed reference monitor | Displays speed reference in % |
| 3 | Input signal monitor | Sequence input signal ON/OFF |
| 4 | Output signal monitor | Sequence output signal ON/OFF |

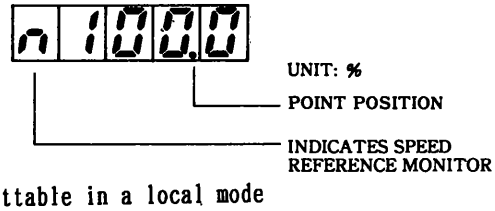
After turning on power, the monitored speed in the drive mode is indicated. Depress the DSPL/ENTR and △ keys simultaneously to change the monitor type. Repeat this operation twice (once for the local mode) to return to indicate the speed monitor during display of the output signal monitor.



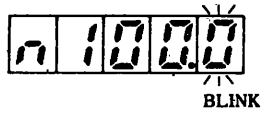

① Speed monitor




② Speed reference monitor



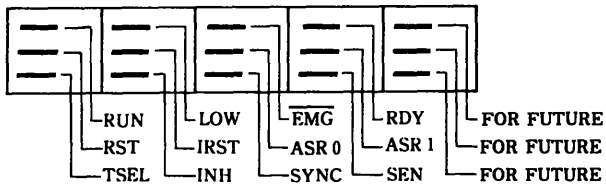

Speed reference is settable in a local mode




- Select the digits to be set by operating the ▷ key. The numerals of the digits which allow values blink.
- Depress the △ key to increase the numeral of the set digit by 1. Set to the desired set value.
- Depress the DSPL/ENTR key after setting values for the digits. The set value can now be used as a speed reference. This set value cannot be stored if power is turned off.

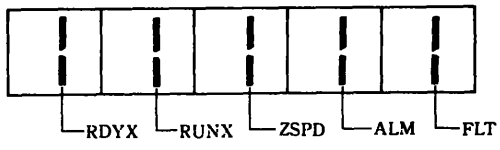
③ Input signal monitor

Supervises an input signal status. When a contact input is "closed", a relevant position lights. The status of input signals is monitored. (The applicable location lights if "on" during contact input.)



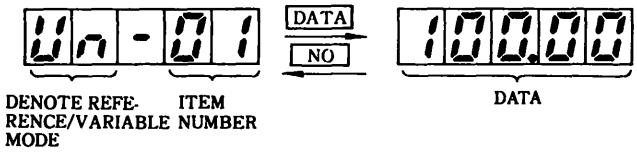

④ Output signal monitor

The status of output signals is monitored. The applicable location lights while output operation is ON.



### 9.3.2 Reference/Variable Display

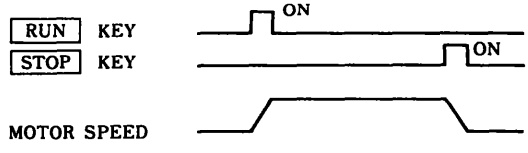
This mode can be set up during the remote mode. Depress [DSPL/ENTR] and [△] keys simultaneously in each monitor mode or error trace mode to change into reference and variable display mode.
Table 9.2 lists up references and variables.



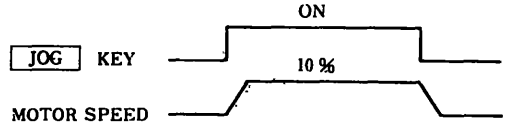

(1) Set an item number by [▷] and [△].
(2) The item number data is displayed by depressing [RUN/DATA].
(3) The item number is displayed by depressing [JOG/NO.].
(4) Repeat (1) through (3) as required.

### 9.3.3 Operation on Monitor Panel

① Select local mode.
Depress [DRIVE/PRG] key to enter program mode. As shown in par 9.4.2, turn on bit data 2-bit (third from the right) of Cn29. Then local mode is selected. (Turn off after the operation.)
② [FWD/REV/MODE] key
Selects forward or reverse at speed control.
FWD or REV LED lights up accordingly.
③ [RUN/DATA] and [STOP/SET] keys
Used instead of sequence input signal [RUN].
Speed control is performed according to a set speed reference (sign depends on [FWD/REV] operation). See par. 9.3.1 ②. When [RUN] or [STOP] key is operated, the LED lights.




④ [JOG/NO.] key
For jogging. Jog speed reference is 10 % (sign depends on [FWD/REV/MODE] key) of user constant Cn01 (rated speed).



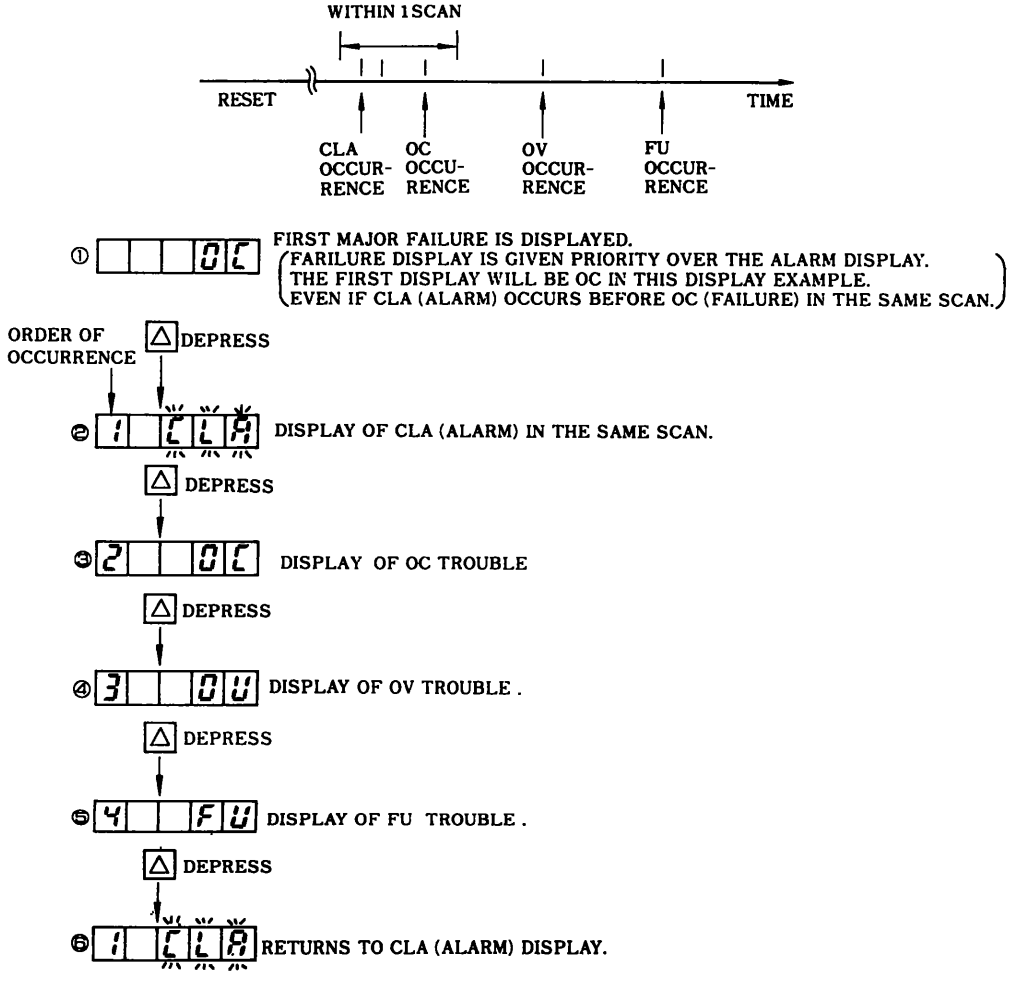

⑤ Sequence input
[RDY], [EMG], [IRST], [RST] and [SEN] operate as in the remote mode. Switch off all other sequence input by remote selection and raise to local mode selection.

### 9.3.4 Failure Mode

If a failure is detected in the drive mode, the failure mode will set up and failures and alarms of 28 types as shown in Table 9.4 are displayed regardless of the display mode.

- Failure display sequence

  If several failures occur, the failure occurrence sequence after error resetting will be displayed in a maximum of eight types.



### 9.3.5 Failure Trace

In the failure trace function, details of failures that have occurred before a power failure are stored in the NV-RAM and are displayed when power is restored.

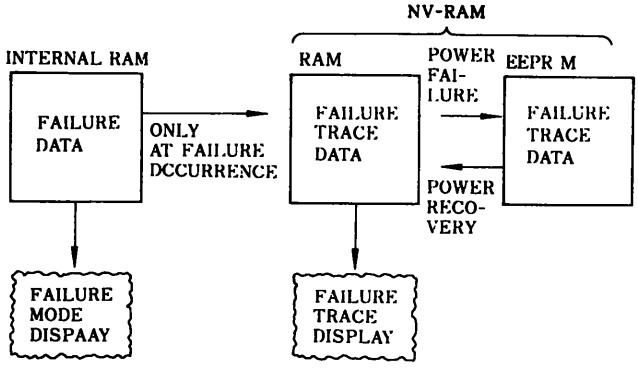
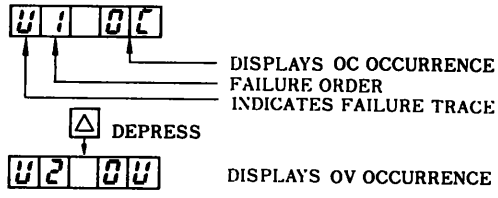



Fig. 9.3 Saving Failure Date

Failure trace display is the same as failure mode display except "U" is displayed before failure occurrence Nos.

Example :

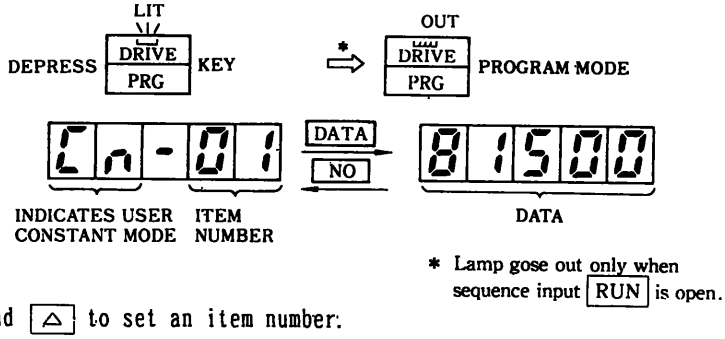



## 9.4 PROGRAM MODE

User constants are set or referenced in the program mode.

Table 9.5 lists up user constants. Set them referring to par. 7 "USER CONTANTS".

### 9.4.1 Setting and Referencing User Constants (Data)




(1) Depress ▷ and △ to set an item number.

(2) Depress RUN/DATA to display data of the item number.

(3) Depress ▷ and △ to set data.

(4) Depress STOP/SET and DSPL/ENTR to store the data.

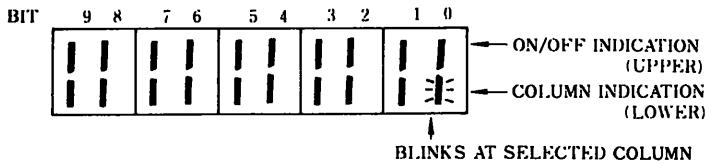
(5) Depressing JOG/NO. returns to the item number display.

(6) Repeat steps (1) to (5) as required.

In case of display only, skip the steps (3) and (4).

### 9.4.2 User Constant (Memory Switch) Setting and Referencing

Data of user constants Cn-29 and 30 is set and referenced by bits as memory switches.




① Select the digit to be set by operating the [▷] key.
The bit (lower side) of the selected digit will blink.
② Depress the [△] key to change the status of the bit (upper side) for switching on and off of the set digit. (Lit if ON, not lit if OFF.)
③ Repeat steps ① and ② as necessary.
④ Depress the [STOP/SET] key and then the [DSPL/ENTR] key to store the data.
Table 9.2 lists the details of the bits of memory switches Cn-29 and -30.

Table 9.2 Status Monitor Functions

| Monitor Display | Abbreviation | Name | Unit | Resolution | Remarks |
|---|---|---|---|---|---|
| Un01 | NREF | Speed reference | % | 0.1 | – |
| Un02 | NFB | Speed feedback | rpm | 1 | – |
| Un03 | TREF | Torque reference | % | 0.1 | – |
| Un04 | TFB | Torque feedback | % | 0.1 | When high accuracy torque regulator is provided |
| Un05 | TLF | Forward torque limit | % | 0.1 | Mortoring under forward running, Regeneration under reverse running |
| Un06 | TLR | Reverse torque limit | % | 0.1 | Mortoring under reverse running, Regeneration under forward running |
| Un07 | 12R | Secondary current reference | % | 0.1 | – |
| Un08 | FLX | Magnetic flux reference | % | 0.1 | – |
| Un09 | 11R | Primary current reference | % | 0.1 | – |
| Un10 | SFR | Slip reference | % | 0.1 | – |
| Un11 | FIR | Primary frequency reference | Hz | 0.01 | – |
| Un12 | MTEMP | Motor temperature | ℃ | 1 | – |
| Un13 | VPN | Main circuit DC voltage | V | 0.1 | – |
| Un14 | STS | Status | HEX | - | See Table 9.3. |
| Un15 | SFTNO1 | Software No.1 | - | - | Main unit |
| Un16 | SFTNO2 | Software No.2 | - | - | Option |
| Un17 | 1ADD | CH1 AD data | HEX | | 7FFF/10V, 1CN-3 input data |
| Un18 | 2ADD | CH2 AD data | HEX | | 7FFF/10V, 1CN-5 input data |
| Un19 | 3ADD | CH3 AD data | HEX | | 7FFF/10V, 1CN-7 input data |

Table 9.3 Status (Un 14) Bits

| BIT | Abbrevi-ation | Name | Remarks |
|---|---|---|---|
| 0 | RDYX | Ready | — |
| 1 | RUNX | Run | — |
| 2 | ZSP | Zero speed | — |
| 3 | FOR | Forward | — |
| 4 | REV | Reverse | — |
| 5 | EMG | Emergency stop | — |
| 6 | BB | Base block | — |
| 7 | TLIM | Torque limit | — |
| 8 | CLIM | Current limit | — |
| 9 | NLIM | Speed limit | At torque control |
| 10 | WCHG | Low speed winding select | When winding change unit is optionally used |
| 11 | FLTA | Trouble A | Decelerate and stop |
| 12 | FLTB | Trouble B | Base block |
| 13 | ALM | Alarm | Run continues |
| 14 | NVRAMC | NV-RAM change | — |
| 15 | — | — | — |

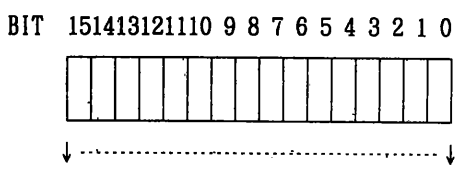


Table 9.4 Failure Display

| No. | Display | Abbreviation | Alarm | Trouble* | Meaning | LIN † | INI † |
|---|---|---|---|---|---|---|---|
| 1 | ROM | ROM | | Ⓢ | PROM | ○ | ○ |
| 2 | NV2 | NV2 | | Ⓑ | NV-RAM2 | | ○ |
| 3 | NV1 | NV1 | | Ⓑ | NV-RAM1 | ○ | ○ |
| 4 | RM0 | RM0 | | Ⓑ | External RAM | | ○ |
| 5 | RM1 | RMI | | Ⓑ | Internal RAM | | ○ |
| 6 | PGC | PGC | | Ⓑ | PG counter error | | ○ |
| 7 | CdE | CDE | | Ⓑ | Constant data error | | ○ |
| 8 | Rd | AD | | Ⓢ | Reference AD converter | ○ | |
| 9 | RdC | ADC | | Ⓢ | CPU AD converter | ○ | |
| 10 | LF | LF | ○ | | Load fault | ○ | |
| 11 | OP | OP | ○ | INIⒷ | Option error | ○ | ○ |
| 12 | OLI | OLI | ○ | | Inverter overload | ○ | |
| 13 | OLM | OLM | ○ | | Motor overload | ○ | |
| 14 | MC | MC | | Ⓢ | NCON error | ○ | |
| 15 | CUV | CUV | | Ⓑ | Control UV | ○ | |
| 16 | PUV | PUV | | Ⓢ | Power UV | ○ | |
| 17 | APG | APG | ○ | | ABS PG error | ○ | |
| 18 | WCG | WCG | | Ⓑ | Winding change error | ○ | |
| 19 | FU | FU | | Ⓑ | Fuse blow | ○ | |
| 20 | PG | PG | | Ⓑ | PG open circuit | ○ | |
| 21 | OS | OS | | Ⓢ | Overspeed | ○ | |
| 22 | OHL | OHL | | Ⓢ | Thermistor open circuit | ○ | |
| 23 | OHI | OHI | | Ⓢ | Inverter overheat | ○ | |
| 24 | OH2 | OH2 | | Ⓢ | Inverter low-frequency overload | ○ | |
| 25 | OHM | OHM | | Ⓢ | Motor overheat | ○ | |
| 26 | OV | OV | | Ⓑ | Overvoltage | ○ | |
| 27 | VL | VL | ○ | | Overvoltage | ○ | |
| 28 | OC | OC | | Ⓑ | Overcurrent | ○ | |
| 29 | CLA | CLA | ○ | | Overcurrent | ○ | |
| 30 | ••••••• | — | | Ⓑ | CPU down | ○ | ○ |

○: Occurring *Ⓢ: Stop Ⓑ: Base block (coasting)

†LIN : on line INI : initial

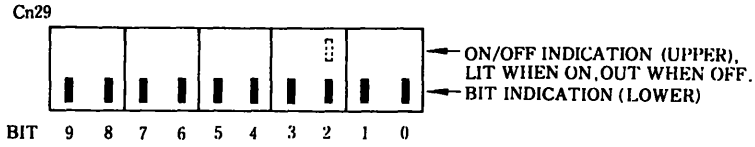
Table 9.5 User Constants (Cn-01 to Cn-30)

| No. | Abbreviation | Name | Unit | Low Limit | High Limit | Factory set at: |
|---|---|---|---|---|---|---|
| Cn01 | *N100 | Rated speed | r/min | 500 | 2000 | 1500 (for 1500rpm series) |
| | | | | | 1000 | 750 (for 750rpm series) |
| Cn02 | NADJ | Speed reference adjust gain | — | 0.6000 | 3.0000 | 1.0000 |
| Cn03 | NOFS | Speed zero adjust | HEX | F488 (-3000) | BB8 (3000) | 0 |
| Cn04 | PASR1 | Speed control P set 1 | — | 0 | 250 | 20 |
| Cn05 | TASR1 | Speed control I set 1 | ms | 5 | 1000 | 50 |
| Cn06 | PASR2 | Speed control P set 2 | — | 0 | 250 | 40 |
| Cn07 | TASR2 | Speed control I set 2 | ms | 5 | 1000 | 50 |
| Cn08 | PASR3 | Speed control P set 3 | — | 0 | 250 | 60 |
| Cn09 | TASR3 | Speed control I set 3 | ms | 5 | 1000 | 50 |
| Cn10 | PASR4 | Speed control P set 4 | — | 0 | 250 | 110 |
| Cn11 | TASR4 | Speed control I set 4 | ms | 5 | 1000 | 50 |
| Cn12 | SFS | Soft starter | s | 0.000 | 10.000 | 0.000 |
| Cn13 | ZSP | Zero speed level | % | 0.0 | 20.0 | 2.0 |
| Cn14 | SMADJ | Speedometer adjust | — | 0.90 | 1.10 | 1.00 |
| Cn15 | TMADJ | Torque meter adjust | — | 0.90 | 1.10 | 1.00 |
| Cn16 | $GD^2$ | Load JL | — | 0.00 | 10.00 | 0.00 |
| Cn17 | TEMG | Emergency stop torque | % | 0.0 | 350.0 | 100.0 |
| Cn18 | *PGRAT | PG frequency dividing ratio | — | 1 | 20032 | 1 (incremental) 8192(absolute) |
| Cn19 | VADJ | Voltage adjust | — | 0.80 | 1.20 | 1.00 |
| Cn20 | TEMP | Ambient temperature | ℃ | -10 | 60 | 20 |
| Cn21 | DTL | ASR output filter | ms | 1.0 | 20.0 | 1.0 |
| Cn22 | TLF | Forward torque limit | % | 0.0 | 350.0 | 350.0 |
| Cn23 | TLR | Reverse torque limit | % | 0.0 | 350.0 | 350.0 |
| | | | | | | |
| Cn29 | *SELCD1 | Select/set constant1 | Bits | 0000000000 | 1111111111 | 0000000000 |
| Cn30 | *SELCD2 | Select/set constant2 | Bits | 0000000000 | 1111111111 | 0000000000 |

Note: Items marked * can be set only when stopping.

Table 9.6 Bits for SELCD 1 and SELCD 2

• Cn29 (SELCD1) select/set value 1

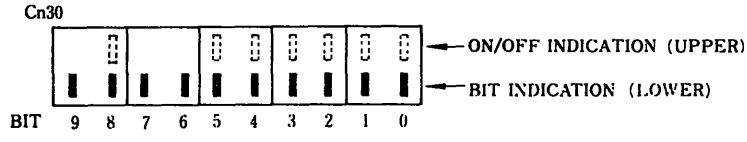



□ :Standard factory-adjusted setting

| Bit | Abbreviation | Name | Setting | |
|---|---|---|---|---|
| | | | OFF | ON |
| 0 | SETRW | Setting-constant setting | Setting/reference disable | Setting/reference enable |
| 1 | OTSEL | Overtravel selecting | Without overtravel | With overtravel |
| 2 | LOCL/REM | Local/Remote | Remote (External reference) | Local (Monitor panel) |
| 3 | NLIMREV | Speed limit polarity | Plus voltage valid | Minus voltage invalid |
| 4 | PTQLREV | Forward torque limit polarity | Plus voltage valid | Minus voltage invalid |
| 5 | TLQSEL | Output during torque limit | Disable | Enable |
| 6 | UCNSEL | Constant change during operation | Disable | Enable |
| 7 | PREF | RS-232C communication mode selection | — | Do not set to ON. |
| 8 | PASOCN1 | | — | |
| 9 | PASOCN2 | | — | |

Note: See par. 8 "SYSTEM DESIGN PRECAUTIONS" for details and operating method.

• Cn30 (SELCD2) select/set value 2




□ :Standard factory-adjusted setting

| Bit | Abbreviation | Name | Setting | |
|---|---|---|---|---|
| | | | OFF | ON |
| 0 | TQCM | Torque control mode | Setting/reference disable | Setting/reference enable |
| 1 | SPDSEL | Speed reference voltage | 6V/100% | 10V/100% |
| 2 | TRQSEL | Torque reference voltage | 3V/100% | 6V/100% |
| 3 | 2CH-AD | 1CN-5 input | Enable | Disable |
| 4 | 3CH-AD | 1CN-7 input | Enable | Disable |
| 5 | DLMT | Speed limit function | Single side | Both side |
| 6 | FNFSEL | Field forcing | Enable | Do not set to ON. |
| 7 | IPPI | | — | |
| 8 | REVSEL | Rotating-direction selecting | Clockwise rotation* at plus speed reference voltage | Counterclockwise rotation* at plus speed reference voltage |
| 9 | PGNEG | PG disconnection detection | Enable | Disable |

*When viewed from the drive end

Note: See par. 8 "SYSTEM DESIGN PRECAUTIONS" for details and operating method.

# 10. INSTALLATION AND WIRING

This motor has been put through severe tests at the factory before shipped. After unpacking, however, check and see the following.

- Its nameplate ratings meet your requirements.
- It has sustained no damage while in transit.
- The output shaft should be hand-rotated freely. However, the brake-mounted motor does not rotate as it is shipped with the shaft locked.
- Fastening bolts and screws are not loose.

If any part of the motor is damaged or lost, immediately notify us giving full details and nameplate data.

## 10.1 INSTALLATION OF SERVOMOTOR

Servomotor can be installed either in horizontal direction or in the downward direction of vertical axis. When installed in the downward direction of vertical axis, UAACLA-30AA2K and UAACLA-37AA2K types (1500 rpm series) and UAACLL-15AA2K or UAACLL-19AA2K types (750 rpm series) need top cover. External dimensions must be taken into consideration. For installation in the upward direction of vertical axis, contact your YASKAWA.

(1) Before mounting

Wash out anticorrosive paint on shaft extension and flange surface with thinner before connecting the motor to the driven machine.

(2) Location

Use the motor under the following conditions.

- Indoors
- Free from corrosive and/or explosive gases or liquids
- Ambient temperature: 0℃ to +40℃
- Clean and dry
- Accessible for inspection and cleaning

If the AC servomotor is subject to excessive water or oil droplets, protect the motor with a cover. The motor can withstand a small amout of splashed water or oil (IP 44 structure). UAACLA-30AA2K and UAACLA-37AA2K types (1500 rpm) and UAACLL-15AA2K and UAACLL192AK types (750 rpm) have motors of dropproof protected type.

(3) Environmental conditions

Ambient Temperature: 0℃ to +40℃

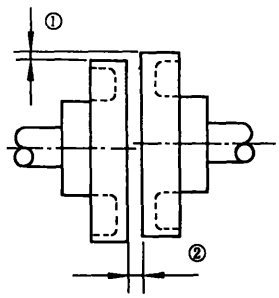
Storage Temperature: -20℃ to +60℃

Humidity: 20% to 80% RH (non-condensing)

(4) Load coupling

True alignment of motor and driven machine is essential to prevent vibration, short bearing and coupling life, or shaft and bearing failures.

Use flexible coupling with direct drive. The alignment should be made in accordance with the figure below.




① Measure the gap between the straightedge and coupling halves at four equidistant points of the coupling. Each reading should not exceed 3/100mm.

② Measure the gap between the coupling faces at four equidistant points around the coupling rim with thickness gage. The maximum variation between any two readings should not exceed 3/100mm.

## 10.2 INSTALLING SERVO DRIVER AND POWER UNIT

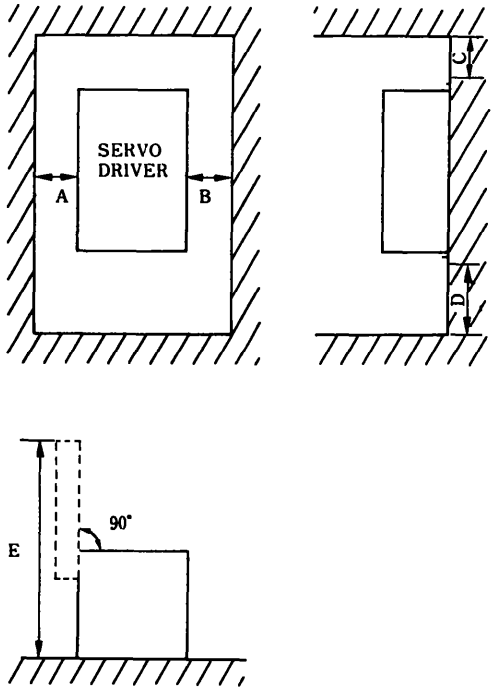
Use VS-866 under the following conditions.

(1) The ambient temperature is 0 to 55℃. When installing in a control panel, consider a cooling design so the interior temperature is not beyond this range.
(2) The humidity is relatively low (90% relative max. Non condensing.)
(3) Not exposed to elements or water drops.
(4) Not exposed to direct sunshine.
(5) Free from dust, metallic powder or corrosive gases.
(6) Not exposed to excessive vibrations.

Install VS-866 vertically with the external wiring downward.

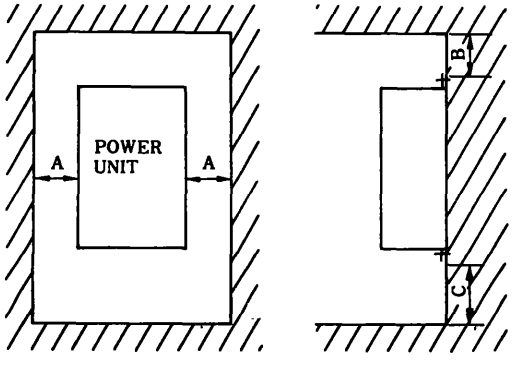
As shown in Figs. 10.1 and 10.2, secure a space for cooling and servicing.

## 10.2 INSTALLING SERVO DRIVER AND POWER UNIT (Cont'd)




| Dimensions / kVA | A | B | C | D | E |
|---|---|---|---|---|---|
| 6 | 85 | 30 | 00 | 100 | 350 |
| 9 | | | | | |
| 13 | | | | | 400 |
| 18 | | | | 150 | 485 |
| 25 | | | | | 515 |
| 35 | | | | | 590 |
| 45 | | | | | 665 |
| 60 | | | | | 790 |
| 80 | | | | | |

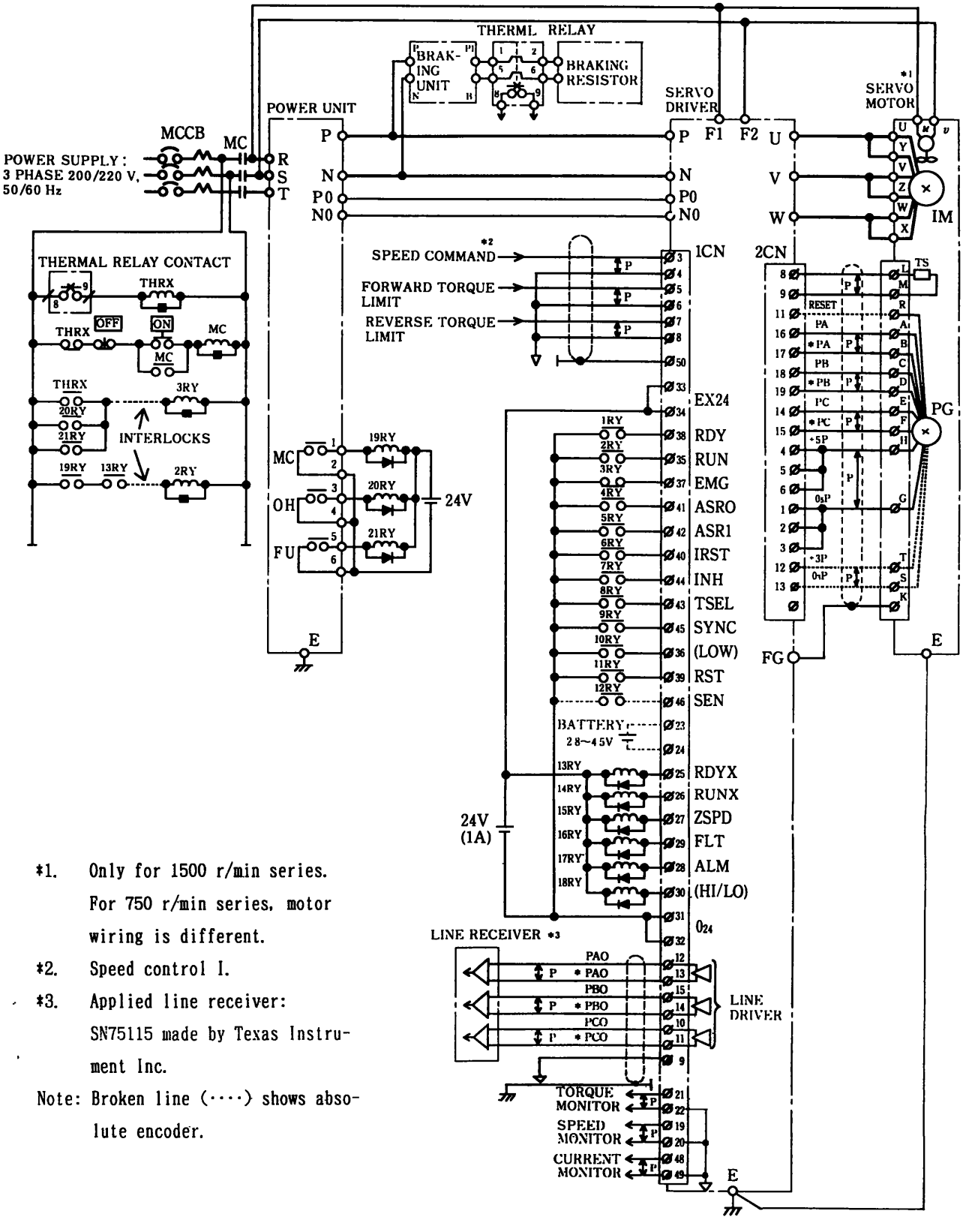
Fig. 10. 1 Location Servo Driver




| Dimensions / MODEL | A | B | C |
|---|---|---|---|
| NPSN-0303L | 30 | 100 | 100 |
| NPSO-0503L | | | |
| NPSO-0803L | | | 150 |
| NPSO-1303L | | | |

Fig. 10.2 Location for Power Unit

## 10.3 WIRING EXAMPLE




*1. Only for 1500 r/min series. For 750 r/min series, motor wiring is different.

*2. Speed control I.

*3. Applied line receiver: SN75115 made by Texas Instrument Inc.

Note: Broken line (····) shows absolute encoder.

Fig. 10.3 Wiring Example

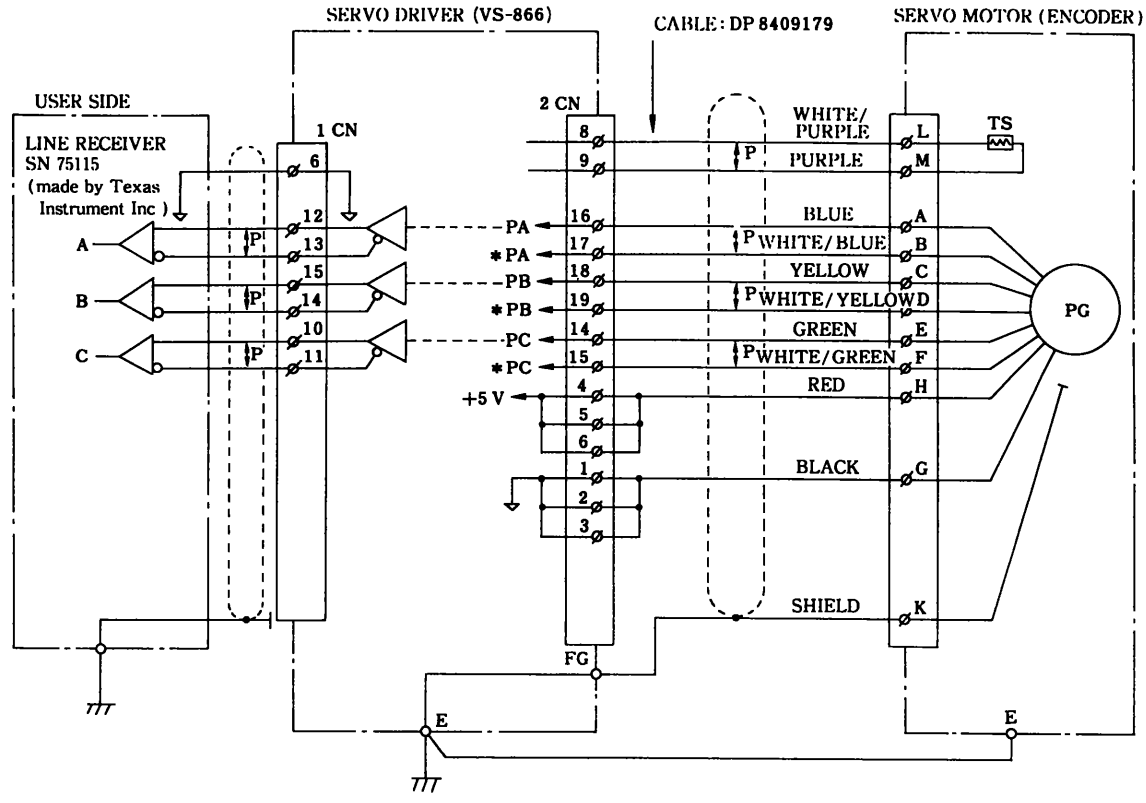



Fig.10.4 Connection of Incremental Encoder and Output Processing

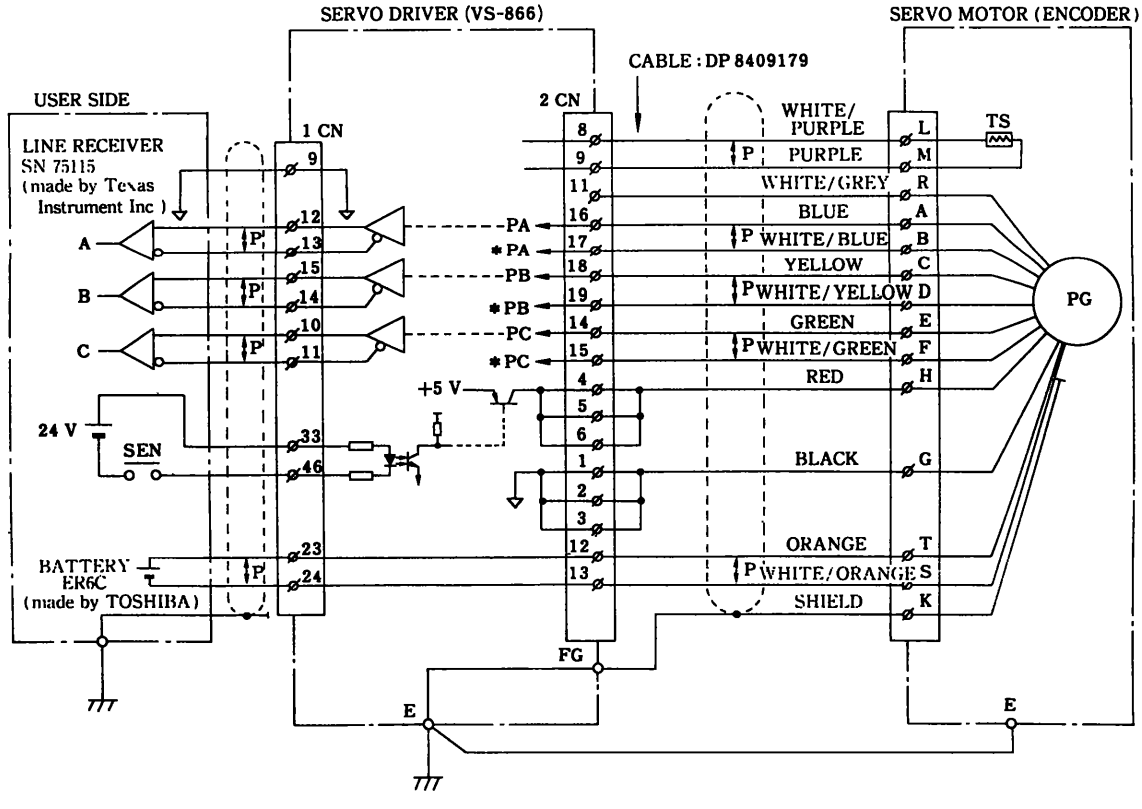



Fig.10.5 Connection of Absolute Encoder and Output Processing

## 10.4 WIRING PRECAUTIONS

Observe the following when installing external interconnection wiring. Check interconnection wiring after installing wiring. Do not check the buzzer of the control circuit.

### 10.4.1 Main Circuit Wiring

(1) A wiring circuit breaker (MCCB) and a magnetic contactor (MC) are recommended to be connected between the AC main circuit power supply and power supply unit input terminals R, S and T.

(2) Select an earth (ground) leakage breaker with a sensitivity current of 200mA or more and operating time of 0.2sec or more to prevent malfunction. The type must be suitable for use of an inverter and not to be activated by a shock wave.

(3) Be sure to connect a surge absorber to magnetic contactors, control relays and solenoid brake coils used near the controller. Table 10.1 shows recommended surge absorbers.

Table 10.1 Application of Surge Absorber (Example)

| Device \ Serge Absorber | | Model | Specifications | Code |
|---|---|---|---|---|
| 200V to 230V | Large capacity coil other than of relay | DCR2-50A22E | 250V AC 0.5 μF + 200 Ω | C 002417 |
| | Control relay LY-2, -3 of Omron, HH-22, -23 of Fuji Electric, NM-2, -4 of Omron | DCR2-10A25C | 250V AC 0.1 μF + 100 Ω | C 002482 |

Note : The surge absorber is manufactured by Marcon Electronics.

(4) The phase rotation directions of the power supply unit input terminals R, S and T can be in any direction.

(5) Do not connect power supply to the output terminals U, V and W.

(6) Connect the servo driver output terminals U, V and W matching with the motor terminals U, V and W.

(7) The wire connections of the motors of the 1500 and 750 rpm series differ. Check this before making connections.

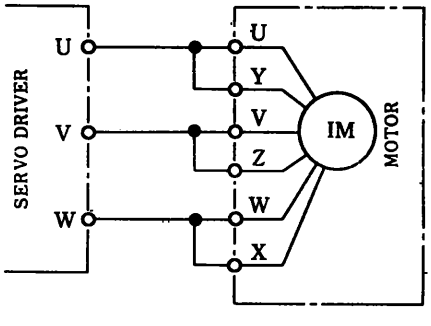



Fig.10.6 1500r/min Series Motor Wiring

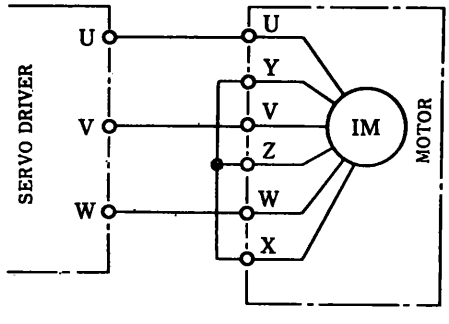



Fig.10.7 750r/min Series Motor Wiring

(8) Never connect a power factor capacitor, radio noise filter or reactor between the controller and motor.

(9) Do not connect the output sides (Po and B) of the damping units by common wiring if several braking units are installed in parallel.

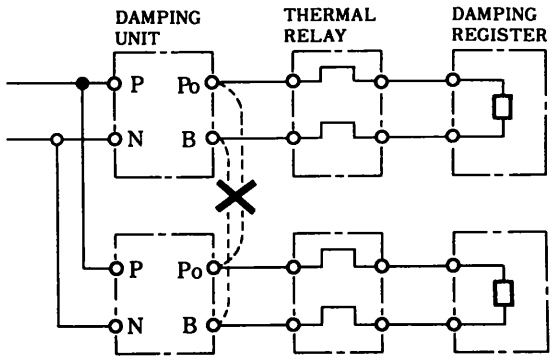



Fig.10.8

### 10.4.2 Control Circuit Wiring

(1) Separate the control circuit wiring (connector terminal 1CN and 2CN connecting cable) from main circuit wiring (N, P, U, V, W, F1, F2) or power cables.

(2) For control wiring, use twist shielded wires or twist pair shielded wires and process the ends as shown in Fig. 10.5 to avoid malfunction by noise. The wire length must be less than 20m.

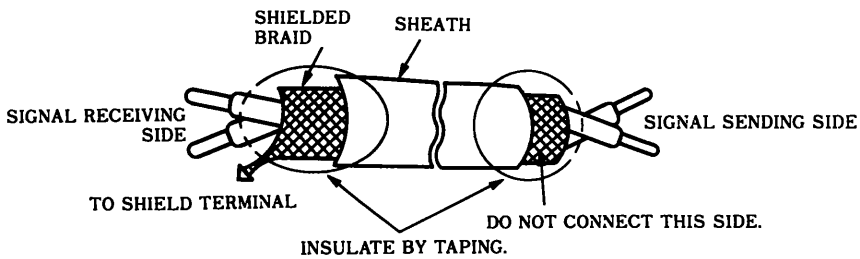



Fig.10.9 Shielded Wire End Process

### 10.4.3 Grounding Wire

Perform grounding firmly in the following procedures. Wrong grounding may cause a malfunction.

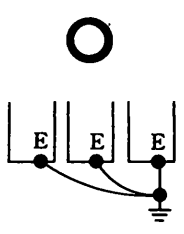
(1) Connect the control device grounding terminal E to 100Ω max..

(2) Do not use the grounding cable or electrode together with welder or other heavy duty equipment. Separate the grounding wire away from that of large-current electrical equipment.

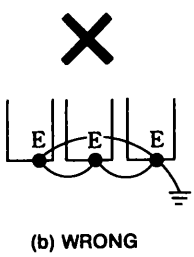
(3) Determine the grounding cable size in conformity with the technical standard for electric facilities; and make the length as short as possible.

(4) Even when the control device or motor is grounded through channel base, iron plate, etc., connect the grounding terminal to ground without fail.

(5) When there are several control devices, perform grounding as shown in Fig. 10.10 (a) without making a loop as shown in (b). No loop is allowed between control device and motor. [Fig. 10.11(b)]

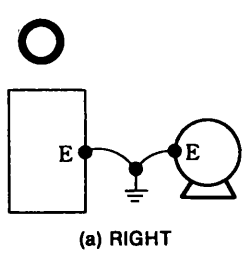



(a) RIGHT

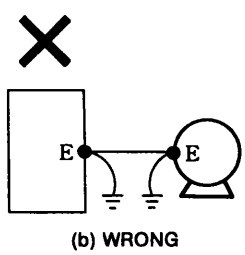



(b) WRONG

Fig.10.10 How to Ground Several Control Devices




(a) RIGHT




(b) WRONG

Fig.10.11 How to Ground Motor and Control Device

## 10.5 TERMINALS

Tables 10.2 and 10.3 list the power unit and servo driver terminals.

**Table 10.2 Power Unit Terminals**

| Symbol | | Name | Description |
|---|---|---|---|
| Main Circuit | R, S, T | Main circuit power input terminal | 3 phases, 200/220 V AC, 50/60 Hz |
| | P, N | Main circuit DC output terminal | 240-340 V DC for servo driver main circuit power |
| | P1, P2 | DC reactor terminal | Shorted normally. (Already shorted at factory) |
| Control Circuit | PO, NO | Control power output terminal | 240-340 V DC for servo driver control power |
| | 1, 2 | Contactor answer signal terminal | Closed when main circuit magnetic contactor is ON. |
| | 3, 4 | Converter overheat signal terminal | Closed when overheated. |
| | 5, 6 | Fuse blown signal terminal | Closed when fuse is blown. |

**Table 10.3 Servo Driver Terminals**

| Symbol | | Name | Description |
|---|---|---|---|
| Main Circuit | P, N | Main circuit power input terminal | 240-340 V DC supplied from power unit |
| | U, V, W | Servo driver output terminal | Connected to motor terminals U, V, W, X, Y, Z |
| Control Circuit | PO, NO | Control power input terminal | 240-340 V DC supplied from power unit |
| | F1, F2 | Fan power input terminal | Single phase, 200/220 VAC, 50/60 Hz |
| | E | Ground terminal | Earth(ground). Class 3 or better |
| | 1CN | Input/output single connector terminal | Rererence input, sequence I/O monitor output, PG output |
| | 2CN | PG connector terminal | PG signal, PG power, motor temperature detect signal |

(MR-50)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| +15V | SG | VREF | SG | FTLM | SG | RTLM | SG | SG | PCO | *PCO | PAO | *PAO | *PBO | PBO | — | — | FG |
| | | Speed reference input | | Forward torque limit input | | Reverse torque limit input | | | PG output signal (C phase) | | PG output signal (A phase) | | PG output signal (B phase) | | | | |
| | | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | | |
| | | VMONI | SG | TMONI | SG | BAT | SG | RDYX | RUNX | ZSPD | ALM | FLT | H/L | COM | COM | | |
| | | Speed monitor | | Torque monitor | | Battery input | | Ready | Run | Zero speed | Alarm | Fault | winding change answer | Common | | | |
| | | | | | | | | Sequence output | | | | | | | | | |
| 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 |
| EX24V | EX24V | RUN | LOW | EMG | RDY | RST | IRST | ASRO | ASR1 | TSEL | INH | SYNC | SEN | — | IMONI | SG | FG |
| External power source | | Run | Low speed select | Emergency stop | Ready | Fault reset | ASR integration reset | ASR constant select | | Torque control | Read inhibit | Sync signal | Sensor ON | | Current monitor | | |
| Sequence input | | | | | | | | | | | | | | | | | |

**1CN terminal arrangement**

(MR-20)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| 0V | 0V | 0V | +5V | +5V | +5V | 0V |
| PG 0V | | | PG 5V | | | |

| 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|
| THM + | THM − | — | Reset | BAT + | BAT − |
| Thermistor input | | | | Battery input | |

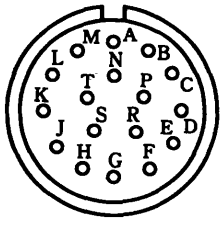
| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|
| PC | *PC | PA | *PA | PB | *PB | — |
| PG input signal (C phase) | | PG input signal (A phase) | | PG input signal (B phase) | | |

SG : signal ground

FG : frame ground

**2CN terminal arrangement**

Fig.10.12 Servo Driver 1CN and 2CN Terminal




| | | | |
|---|---|---|---|
| A | A channel output (PA) | K | Shielded |
| B | $\overline{A}$ channel output (*PA) | L | Thermistor |
| C | B channel output (PB) | M | Thermistor |
| D | $\overline{B}$ channel output (*PB) | N | — |
| E | Z channel output (PC) | P | — |
| F | $\overline{Z}$ channel output (*PC) | R | Reset |
| G | 0 V | S | 0 V (battery) |
| H | +5 V DC | T | 3 V (battery) |
| J | F.G (frame ground) | - | — |

(Note)

Note: R, S and T are for absolute encoder. (Connection is not required for incremental type.)

Fig.10.13 Arrangement Detector (PG) Receptacle Terminal

## 10.6 WIRE

Tables 10.4 and 10.5 list recommended wires for VS-866. The recommended wire sizes are based on wires of an allowable conductor temperature of 80℃, ambient temperature of 55℃ and not bundled. If other wires are used, the wire sizes will differ. If wires are to be bundled or are put in a wire duct, the ambient temperature differs and the allowable current decreases. These factors must be taken into consideration when wires are selected.

**Table 10.4 Power Unit Wires (Reference)**

| Rated Output kW (HP) | | 7.5 (10) | 15 (20) | 25 (33) | 40 (53) |
|---|---|---|---|---|---|
| Main Circuit AC Input | Power Capacity kVA | 10 | 20 | 30 | 50 |
| | Applied wire mm² (AWG) | 3.5 (12) | 8 (8) | 22 (4) | 38 (1) |
| R, S, T | Terminal Thread | M5 | M6 | M8 | M8 |
| Main Circuit DC Output | Current A | 33 | 65 | 103 | 168 |
| | Applied wire mm² (AWG) | 3.5 (12) | 14 (6) | 22 (4) | 50 (1/0) |
| P, N | Terminal Thread | M5 | M6 | M6 | M8 |
| Control Power DC Output | Current A | 1.2 MAX | | | |
| | Applied Wire mm² (AWG) | 1.25 (16) | | | |
| PO, NO | Terminal Thread | M4 | | | |
| Control Circuit | Applied Wire mm² (AWG) | 1.25 (16) | | | |
| 1 - 6 | Terminal Thread | M4 | | | |
| Grounding | Applied Wire mm² (AWG) | 3.5 (12) | | | |
| E | Terminal Thread | M4 | | | |

Table 10.5 Servo Driver Wires (Reference)

| Rated Capacity kVA | | 6 | 9 | 13 | 18 | 25 | 35 | 45 | 60 | 80 |
|---|---|---|---|---|---|---|---|---|---|---|
| Main Circuit DC Input | Current A | 25 | | 30 | 43 | 58 | 85 | 116 | 170 | 200 |
| | Applied wire mm² (AWG) | 3.5 (12) | | 3.5 (12) | 5.5 (10) | 8 (8) | 22 (4) | 30 (2) | 50 (1/0) | 60 (2/0) |
| P, N | Terminal thread | M4 | | M5 | M6 | M6 | M6 | M8 | M8 | M8 |
| Servo Driver Output | Current A | 27 | | 40 | 55 | 80 | 110 | 133 | 190 | 240 |
| | Applied wire mm² (AWG) | 3.5 (12) | | 5.5 (10) | 8 (8) | 14 (6) | 22 (4) | 30 (2) | 60 (2/0) | 60 (2/0) |
| U, V, W | Terminal thread | M4 | | M5 | M6 | M6 | M8 | M8 | M8 | M8 |
| Control Power Input | Current A | 0.3 | | | | | | | | |
| | Applied wire mm² (AWG) | 1.25 (16) | | | | | | | | |
| P0, N0 | Terminal thread | M4 | | | | | | | | |
| Fan Power Input | Applied wire mm² (AWG) | 1.25 (16) | | | | | | | | |
| F1, F2 | Terminal thread | M4 | | | | | | | | |
| Ground | Applied wire mm² (AWG) | 3.5 (12) to 5.5 (10) | | | | | | | | |
| | Terminal thread | M4 | | | | | | | | |

Note : The table below shows the maximum connecting wire sizes when round compression terminal (JIS C2805) is used for wiring.

| Rated Capacity kVA | 6 | 9 | 13 | 18 | 25 | 35 | 45 | 60 | 80 |
|---|---|---|---|---|---|---|---|---|---|
| P, N Terminals mm²(AWG) | 5.5 (10) | | 8 (8) | 14 (6) | 22 (4) | 22 (4) | 38 (1) | 60 (2/0) | 60 (2/0) |
| U, V, W Terminals mm²(AWG) | 5.5 (10) | | 8 (8) | 14 (6) | 22 (4) | 38 (1) | 60 (2/0) | 60 (2/0) | 60 (2/0) |

Table 10.6 1CN and 2CN Receptacles (provided by Yaskawa)

| | Manufacturer | Model | Specifications |
|---|---|---|---|
| 1CN | Honda Tsushin Kogyo | MR-50LF | Soldered type (50P) |
| 2CN | | MR-20LF | Soldered type (20P) |

Table 10.7 Arrangement Detector (PG) Receptacle (Prepared by User)

| Name | Model |
|---|---|
| Receptacle | MS3102A20-29P |
| L-type Plug | MS3108B20-29S |
| Cable Clamp | MS3057-12A |

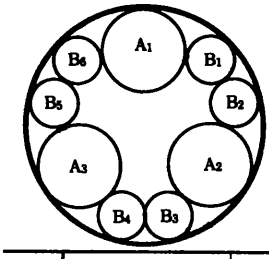
**Table 10.8 Typical 1CN and 2CN Cables (Prepared by User)**

| | Size | Number of Cores |
|---|---|---|
| 1CN | 0.3 $mm^2$ | Coaxical, 50 cores *1 |
| 2CN | 0.5$mm^2$×3<br>0.2$mm^2$×6P | In pair, stranded *2 |

*1 : Vinyl coated wires for electrical equipment can be used with 1CN signal wires, with the exception of analog signal wires.
Pay attention to the following when selecting signal wires.
- Install signal wires separate from the main circuit wiring and install point-to-point with the shortest possible distances to minimize effects of noise.
The outside dimensions of bundled wires must be smaller than the connector outlet.
(MR-50LF: $\phi$16, MR-20LF: $\phi$11)

*2 : Use composite KQVV-SW DP8409179 (AWG 16 x 3C, AWG 26 x 6P) manufactured by Fujikura.

Table 10.9 Typical 2CN-PG Cables

| | |
|---|---|
| Yaskawa Drawing No. | DP8409179 |
| Manufacturer | Fujikura Cable Co. |
| Specifications | Composite KQVV-SW<br>AWG 16×3C<br>AWG 26×6P |
| Connection Method | Soldering |
| Internal Composition and Lead Color |  <br> |

| | | |
|---|---|---|
| $A_1$ | Red | |
| $A_2$ | Black | |
| $A_3$ | Green yellow | |
| $B_1$ | Blue-white/blue | Twisted cable |
| $B_2$ | Yellow-white/yellow | |
| $B_3$ | Green-white/green | |
| $B_4$ | Orange-white/orange | |
| $B_5$ | Purple-white/purple | |
| $B_6$ | Grey-white/grey | |

## 10.7 POWER LOSS

Tables 10.10 and 10.11 show power loss of servo driver and power supply unit.

**Table 10.10 Power Loss of Servo Driver (at Reted Output)**

| Series | Type CIMR-SVJ- | Power Loss W (HP) |
|---|---|---|
| 1500 rpm | 03A | 210 (280) |
| | 04A | 300 (400) |
| | 16A | 340 (453) |
| | 08A | 550 (733) |
| | 11A | 700 (933) |
| | 15A | 950 (1267) |
| | 22A | 1470 (1960) |
| | 30A | 1670 (2227) |
| | 37A | 2300 (3067) |
| 750 rpm | 03L | 210 (280) |
| | 04L | 270 (360) |
| | 06L | 420 (560) |
| | 08L | 540 (720) |
| | 11L | 710 (947) |
| | 15L | 980 (1307) |
| | 19L | 1300 (1733) |

**Table 10.11 Power Loss of Power Unit**

| Type | Power Loss W |
|---|---|
| NPSN-0303L | 70 (93) |
| NPSO-0503L | 120 (160) |
| NPSO-0803L | 180 (240) |
| NPSO-1303L | 290 (387) |

# 11. TEST RUN

## 11.1 PREPARATIONS

Check the following items before making trial operation.

(1) Is power within the rated value?

(2) Are I/O connections of the main and control circuits correct?

- Input side of power supply unit (power supply side) (Phase revolution is optional)···· Ⓡ, Ⓢ, Ⓣ
- Power supply unit ⟷ servo driver ···· Ⓟ, Ⓝ, Ⓟ0, Ⓝ0

  Inverse connection of P and N may damage the equipment.
- Servo driver ⟷ motor ····· Ⓤ, Ⓥ, Ⓦ

  Normal operation is not possible if phase rotation is incorrect.
- Motor wire connections

  1500 rpm series: Delta connection

  750 rpm series: Star connection

(3) Connection with an encoder (PG).

(4) Operation of the external sequence circuit.

## 11.2 CONTROLLER CHECK (POWER ON)

Turn power on after checking that sequence input [RUN] switched off and the speed reference input is 0V.

Turn power on and check the indicator lamps and display as follows.

Power supply unit
- SOURCE lamp lit (white)
- CHARGE LED lit (red)

Servo driver
- Monitor panel "0" displayed
- CHARGE LED lit (red)

Check in accordance with section 12, "TROUBLESHOOTING", if wrong data is displayed or if the display is different from the display items mentioned above when power is turned on.

## 11.3 CONSTANT SETTING

Set in accordance with sect. 7 "USER CONSTANTS" and sect. 9 "MONITOR PANEL OPERATION", matching the machine specifications. Set speed zero adjustment (Cn03) and voltage adjustment (Cn19) as follows:

(1) Speed zero adjustment (Cn03)

The necessary adjustment was made at the factory prior to shipment and no readjustment is needed. However, if fine adjustment is necessary, adjustment is possible using this constant.

Adjusting method:

① Input 0V as the speed reference (1CN between 3 and 4).

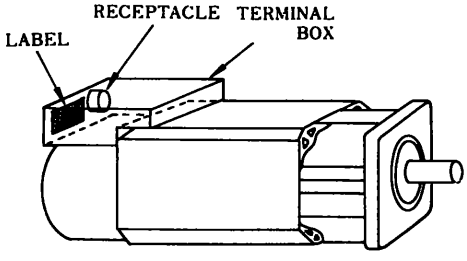
② Operate the monitor panel and read by displaying CHI AD data (Un17)

③ Set the value of Un17 in Cn03.

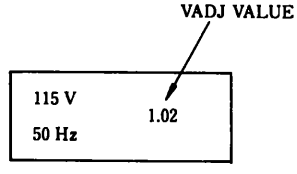
(2) Voltage adjustment (Cn19)

This is the constant to set dispersions of the motor circuit constant.

① Set VADJ value expressed on the label in motor terminal box at Cn19.




LABEL POSITION




LABEL EXAMPLE

## 11.4 TRIAL OPERATION METHOD

Operate the servo motor without a load in trial operation to avoid unexpected troubles. If trial operation must be performed mounted on an other machine, perform trial operation in a condition that allows an emergency stop anytime.

NOTE

- Be sure to perform trial operation in the SPEED CONTROL mode.
- If the $J_L$ is less than 1/2 of the $J_M$ such as the motor alone installed without a load, set the speed controller proportional gain (Cn04) to 10. The motor may hunt if the gain is high.
- Switch on the sequence input EMG during trial operation, but allow the input to be switched off anytime if trouble occurs.
- Check the installation of the motor and secure the safety around the motor shaft before starting operation.

### 11.4.1 Operation on Monitor Panel

Read Par. 9 "MONITOR PANEL OPERATION" thoroughly before operation.

(1) Select local mode. (Monitor panel operation)
Turn on 2 bits of C n 2 9.

(2) Close sequence input [RDY], [EMG] ( RDY, EMG )

(3) Motor rotates while [JOG/NO.] on the monitor panel is depressed. (10% speed) Check that the motor rotates correctly.

(4) Depressing [△] key changes the mode into speed reference mode with [DSPL/ENTR] depressed. Key in speed reference (%). For safety operation, key in 10% for the beginning.

Example:

| [Operation] | [Display] | |
|---|---|---|
| When the power is ON; | 0 | Speed monitor (r/min) |
| • Depress [DSPL/ENTR] and [△] simultaneously. | n 0.0 | Speed reference (%) monitor (r/min) |
| • Depress [▷] several times to make digit to be changed blink. (Twice in this example) | n 00.0 Blinks | |
| | n 01.0 Blinks | Speed reference 10% |
| • Values are changed by depressing [△] for a desired value. | n 01.0 | Setting completed |
| • Depress [DSPL/ENTR] | | |

(5) Depress [RUN/DATA], the motor rotate at a set speed.
[FWD/REV/MODE] changes the rotating direction.

(6) Increase the set value of speed reference slowly enough to check if there is no abnormal noise, smell or vibration.

(7) Depress [STOP/SET] to stop the motor.

### 11.4.2 Operation by External Reference

(1) Switch on (close) sequence input [RDY] after checking that the speed reference input is 0V. An excitation current flows to the motor at this time.

(2) Input approximately 1.5V (50%) to forward-side torque limitation (1CN5-6) and inverse-side torque limitation (1CN7-8). Input of limit valules is not necessary if external torque limitation is not used (if Bits 3 and 4 of Cn30 are set to ON).

(3) Switch on (close) sequence input [RUN] and slowly increase the speed reference from 0V to rotate the motor at a speed proportional to the reference voltage.

(4) The motor rotates in a forward direction (counterclockwise as viewed from the load side) if the reference voltage is positive. The motor rotates in a reverse direction if the voltage is negative. (See Fig. 11.1)

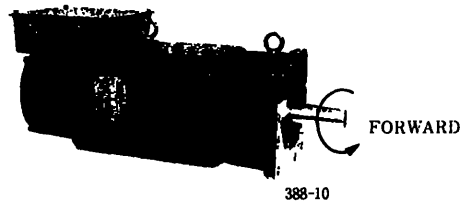



Fig. 11.1 Motor Forward Direction

### 11.4.3 Checking for Test Run

At test run, check the following.

- Abnormal vibration
- Unusual noise
- Excessive temperature

In case of error occurrence, refer to Par. 12. "TROUBLESHOOTING".

### 11.4.4 Setting up Absolute Encoder

It is necessary to store a machine original point or reference position with the absolute encoder installed on the machine (step). For procedure, refer to Par. 6.5.2 (8) "setup "Setup method."

## 12. MAINTENANCE

Plan and perform maintenance and management to keep the VS-866 Drives in good condition.

⚠ - Warning of electric shock

When an inspection is made on the VS-866 do not touch the inside at least 5 miniutes after the power supply is turned OFF. Verify that the smoothing capacitor electric discharge has been completed before starting maintenance.

At this time, the charge indicator lamp "CHARGE" is extinguished.

### 12.1 DAILY CHECK LIST

Check the items listed in the following table daily.

Table 12.1 Daily Check List

| Classification | Check Procedure | | Criteria | Remedy |
|---|---|---|---|---|
| | Check Item | Method | | |
| Ambient | Ambient temperature | Thermometer | Inverter: 0℃ to +55℃ (Above freezing) Motor: 0℃ to +40℃ | Improve installantion environment to meet the specification. |
| | Humidity | Hydrometer | 90% RH or lower (Non-condensing) | Keep to the specification. |
| | Ventilation | Visual check | Entry and exhaust ports must not be obstructed. | Remove obstacles. |
| Power conditons | Voltage | Voltmeter | Must be form +10% to −15% of rated voltage. | Adjust voltage within the specified range (by a tap changer). |
| | Current | Ammeter | Must not be greater than the rating. Must be free from cyolic fluctuations. | Adjust load. |
| Appearance | Dust and stains (with dust.etc.) on the inverter Dust and stains on the motor shaft opening | Visual check | Must not be present | Clean if dirty. |
| Operation status | Vivration | Touch or use a vibrometer. | Must be free from unusual vibration or increase in magnitude. | If allowable limit is exceeded, stop operation and correct the cause. |
| | Odor | Smell. | Must be free from burning odor. | Stop operation and correct the cause. |
| | Abnormal sound | Listen. | Must be free from unusual sound or increase of noise. | If operation is hindered, stop operation and correct the cause. |
| | Rise of inverter or motor temperature | Touch with care or use a thermometer. | Must be free from excessive temperature rise over normal operating temperature. | Stop operation and cool the system. Check for abnormality in the cooling system (e.g. the fan). Repair if damaged. |
| Around the bearing | Bearing noise | Listen or use a stethoscopic rod. | Must be free from unusual sound or increase of noise. | Replace the bearing. |
| | Vibration | Touch or use a vibrometer. | Must be free from excessive vibration. | |
| | Bearing temperature | Touch with care or use a thermometer. | Must be free from excessive temperature rise over normal operationg temperature. | |
| | Grease | Visual check | Must not be leaking. | Correct the cause and restore the normal condition. |
| Motor cooling Fan | Operation state | Visual or aural check | Normal operation | Correct the cause of fan stoppage or replace the motor if damaged. |

## 12.2 PERIODICAL MAINTENANCE

Observe the following procedures and clean the inverter periodically.

(1) If an air filter is used in the control panel, clean the filter once a month.

(2) Dust on electronic components can lead to overheating and insulation deterioration. Remove dust periodically. Dust or oil on the heat sink placed on the back of the controller may impair heat dissipation and result in a failure. Clean the heat sink once every six months by blowing compressed air or with a dry cloth. (Clean more frequently if necessary.)

## 12.3 PERIODICAL CHECK LIST AND ACTION TO BE TAKEN

Refer to Table 12.2 to plan a maintenance schedule for periodic inspection.

Table 12.2 Periodic Inspection

| Classification | Check Procedure | | Criteria | Remedy |
|---|---|---|---|---|
| | Check Item | Method | | |
| Daily Inspection Conditions | Inspection record | Visual | – | Use the information in periodic inspection. |
| Installation Conditions | Tightening bolts of the inverter and the motor | Visual | Must not be loose. | Tighten the bolts. |
| Grounding | Grounding pins of the inverter and the motor | Visual | Must be grounded securely. | Restore the initial condition and tighten. |
| Coating | Peeling and Corrosion | Visual | Must be free from damage, discoloration, peeling, and corrosion. | Apply anti-corrosion coating. |
| Cables and Connections | Loose connection, break in wire cover, terminal box | Visual | Must be free from loose connection or break. Must be free from deterioration or deformation. | Restore the initial condition and tighten. |
| Cooling Fan | Vibration | Touch. | Must be free from unusual vibration or increase in magnitude. | Replace the cooling fan. |
| | Abnormal sound | Check by hearing | Must be free from unusual sound or increase of noise. | |
| Electrolytic Capacitor | Leak and expansion | Visual Check | Must be free from abnormalities such as leak of liquid or expansion. | Replace the parts. |
| | (Capacitance measurement) | (Capacitance measurement instrument) | (Must be within the specifications.) | |
| Relays and Contactors | Abnormal sound when functioning | Listen. | Must be free from chattering noise. | Replace the parts. |
| Resistors | Cracks in insulating material | Visual check | Must be free from abnormalities. | Replace the parts. |
| | Break in wire | Circuit tester and the like | Must be within the specifications. | |
| PC Board | Discoloration | Visual | Must be free from abnormal or partial discoloration. | Replace the PC board. |
| Control Circuit | Operation check | Inverter standalone operation | Output voltage phases must be balanced well. | Adjust the PC board or repair the inverter. |
| Insulation Resistance | Inverter (Between the main circuit and ground) | Insulation resistance meter | Must be above the specifications. | Repair. |
| | Motor (Between the stator and ground) | | 500VDC 10MΩ or more | Dry the stator windings. If insulation is not within specs, repair. |
| 1. Shaft Coupling | Sunk keys | Visual | Must be free from damage and deformation. | Replace parts. |
| | Shaft coupling without key | | Alignment marks must match. | Restore initial conditions. |
| 2. V-belt | Tightening reamer bolt | | Must not be loose. | Tighten the bolt. |
| | Abrasion | | Abrasion must be slight. | Replace the parts. |

Table 12.2 Periodic Inspection (cont'd)

| Classification | Check Procedure | | Criteria | Remedy |
|---|---|---|---|---|
| | Check Item | Method | | |
| Motor | Bearing | Listen or use a vibrometer. (Period:12000 hours or two years) | Must be free from unusual sound, vibration increase or temperature rise. | Disassemble and replace the worn parts. |
| | Cooling fan | Listen or use a vibrometer. (Period:15000 hours or two years) | | Replace the cooling fan. |

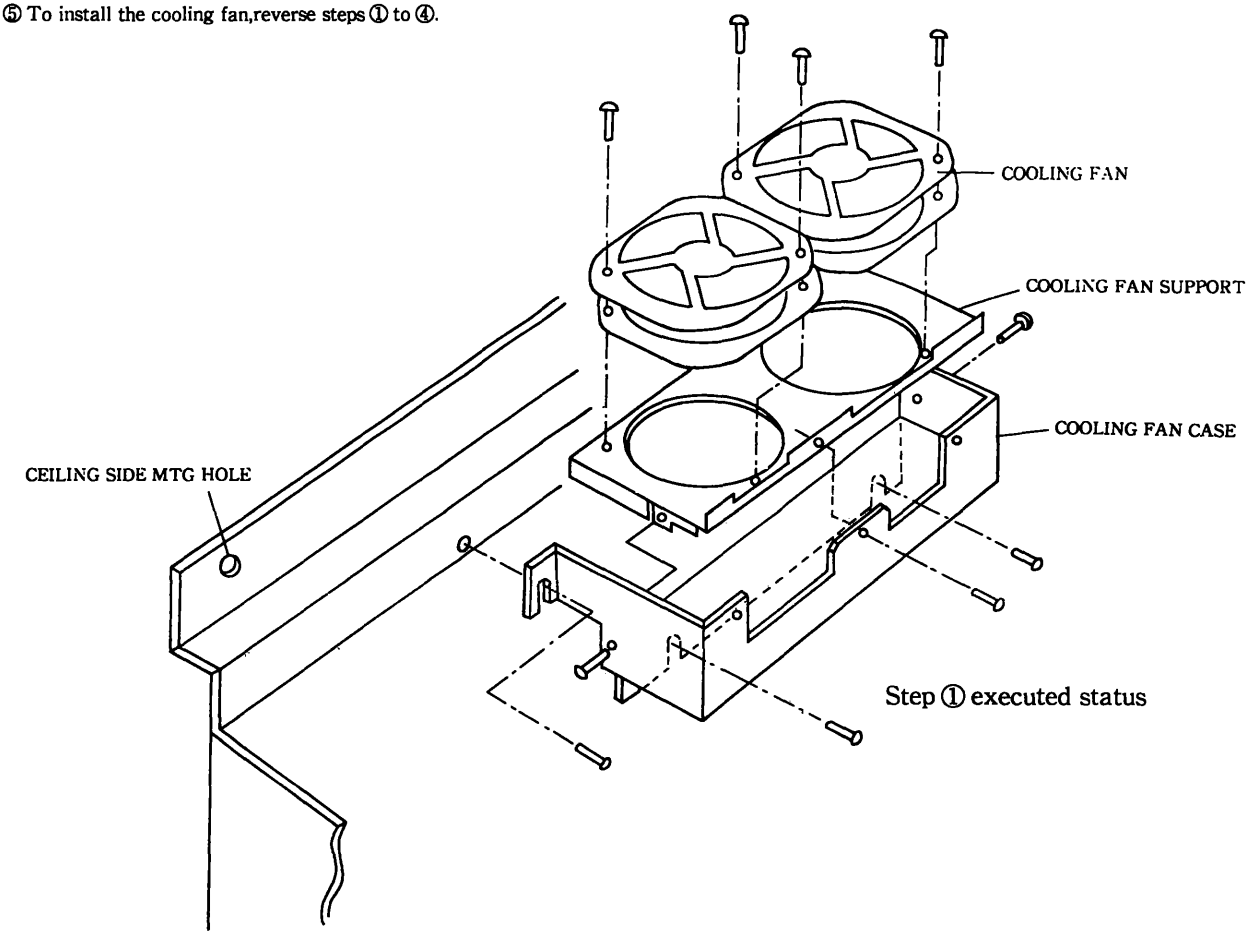
## 12.4 REPLACING THE INVERTER COOLING FAN

The inverter houses a fan for cooling the heat sink. Replace the fan after a total operation time of about 20,000 hours. (See Fig. 12.1)

⚠ – Precaution on replacing the cooling fan

Never replace the cooling fan nor remove/connect cables when power is ON.
(Otherwise, injury by electric shock or the rotating fan may occur.)

① Open the board frame(for control board mounting)and remove the base drive board.
② Remove screws "a" and the cooling fan case.
③ Remove screws "b" and the cooling fan bearing.
④ Remove screws "c" and the cooling fan.
⑤ To install the cooling fan,reverse steps ① to ④.



## 12.5 SPARE PARTS

Servo Driver

| Servo Driver Model | Spare Parts / Specification | Fransistor Module | Fuse | Control Board | Base Drive | Cooling Fan |
|---|---|---|---|---|---|---|
| 03A□□<br>04A□□<br>03L□□ | Model | 6DI10A-050 | CR2LS-50 | Analog input<br>JPAC-C389<br>-S□□□□<br>ETC00920X<br>-S□□□□□ | JPAC-C373 | 4715PS-22T-B30-B00 |
| | Code No. | STR000254 | FU000797 | | ETC00889X | FAN000130 |
| 06A□□<br>04L□□ | Model | 2DI200A-050P-03 | CR2LS-75 | | JPAC-C374 | 4715PS-22T-B30-B00 |
| | Code No. | STR000474 | FU000792 | | ET000890X | FAN000130 |
| 08A□□<br>06A□□<br>08L□□ | Model | QM200DY-H | CR2LS-100 | | JPAC-C375 | 4715PS-22T-B30-B00 |
| | Code No. | STR000288 | FU000794 | | ETC00891X | FAN000130 |
| 11A□□<br>11L□□ | Model | QM300HA-H | CR2L-140 | | JPAC-C376 | 5915PC-22T-B30-B00 |
| | Code No. | STR000173 | FU000793 | | ETC00892X | FAN000131 |
| 15A□□<br>15L□□ | Model | QM400HA-H | CR2L-200 | Digital input<br>JPAC-C388<br>-S□□□□<br>ETC00919X<br>-S□□□□□ | JPAC-C377 | 5915PC-22T-B30-B00 |
| | Code No. | STR000230 | FU000751 | | ETC00893X | FAN000131 |
| 22A□□<br>19L□□ | Model | QM500HA-H | CR2L-260 | | JPAC-C378 | 5915PC-22T-B30-B00 |
| | Code No. | STR000316 | FU000834 | | ETC00894X | FAN000131 |
| 30A□□ | Model | QM400HA-H | CR2L-350 | | JPAC-C379 | 5915PC-22T-B30-B00 |
| | Code No. | STR000231 | FU000795 | | ETC00895X | FAN000131 |
| 37A□□ | Model | QM500HA-H | CR2L-450 | | JPAC-C380 | 5915PC-22T-B30-B00 |
| | Code No. | STR000317 | FU000825 | | ETC00896X | FAN000131 |

Power Unit

| Power Supply Model | Spare Parts / Specification | Rectifier Diode | AC Fuse | DC Fuse | Control Power Fuse | Cooling Fan |
|---|---|---|---|---|---|---|
| NPSN-0303L | Model | 50L6P43 | 25SHA-60S with MS3000-1 | 25SHA-75S with MS3000-1 | P430 | — |
| | Code No. | SID000395 | FU000826 | FU000827 | FU000372 | — |
| NPSO-0503L | Model | 100Q6P43 | 25SHA-125S with MS3000-1 | 25SHA-150S with MS3000-1 | P430 | 4715PS-22T-B30-B00 |
| | Code No. | SID000408 | FU000828 | FU000829 | FU000372 | FAN000130 |
| NPSO-0803L | Model | RM100DZ-H | 25SH-160S with MS3000-1 | 25SH-180S with MS3000-1 | P430 | 4715PS-22T-B30-B00 |
| | Code No. | SID000332 | FU000830 | FU000831 | FU000372 | FAN000130 |
| NPSO-1303L | Model | RM150DZ-H | 25SH-260S with MS3000-1 | 25SH-300S with MS3000-1 | P430 | 4715PS-22T-B30-B00 |
| | Code No. | SID000418 | FU000832 | FU000833 | FU000372 | FAN000130 |

# 13. TROUBLESHOOTING

If an operation trouble has occurred, locate it and take measures properly in the following procedure. If the trouble cannot be remedied by such a procedure, contact your Yaskawa representative.

Precautions During Trouble Diagnosis

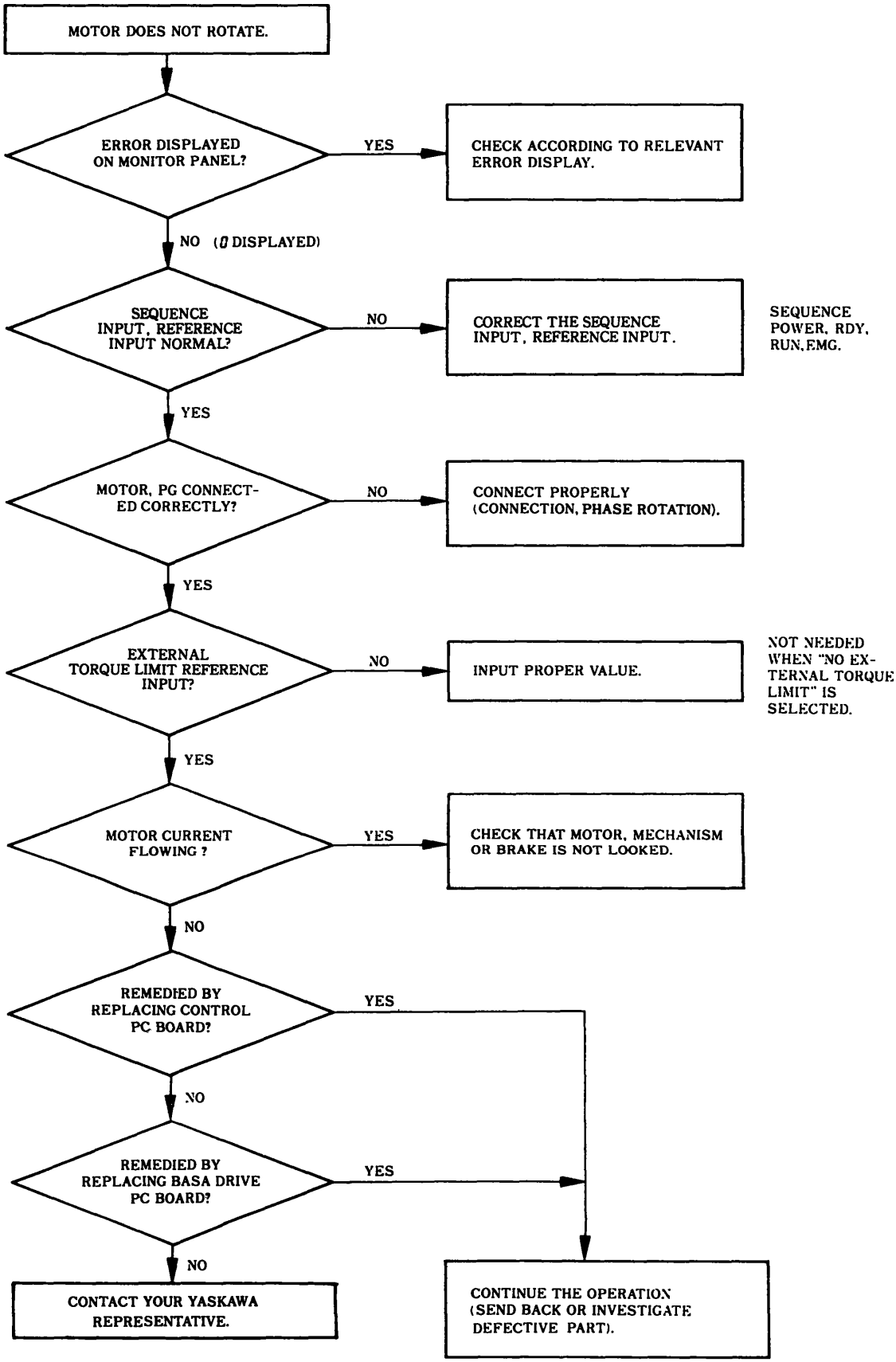
(1) Never remove or reinstall wires when power is supplied.

(2) Check or handle the main circuit only after turning power off and the CHARGE indicator lamp goes out. Measure the DC busbar voltage between P and N using a tester and make sure that it is safe.

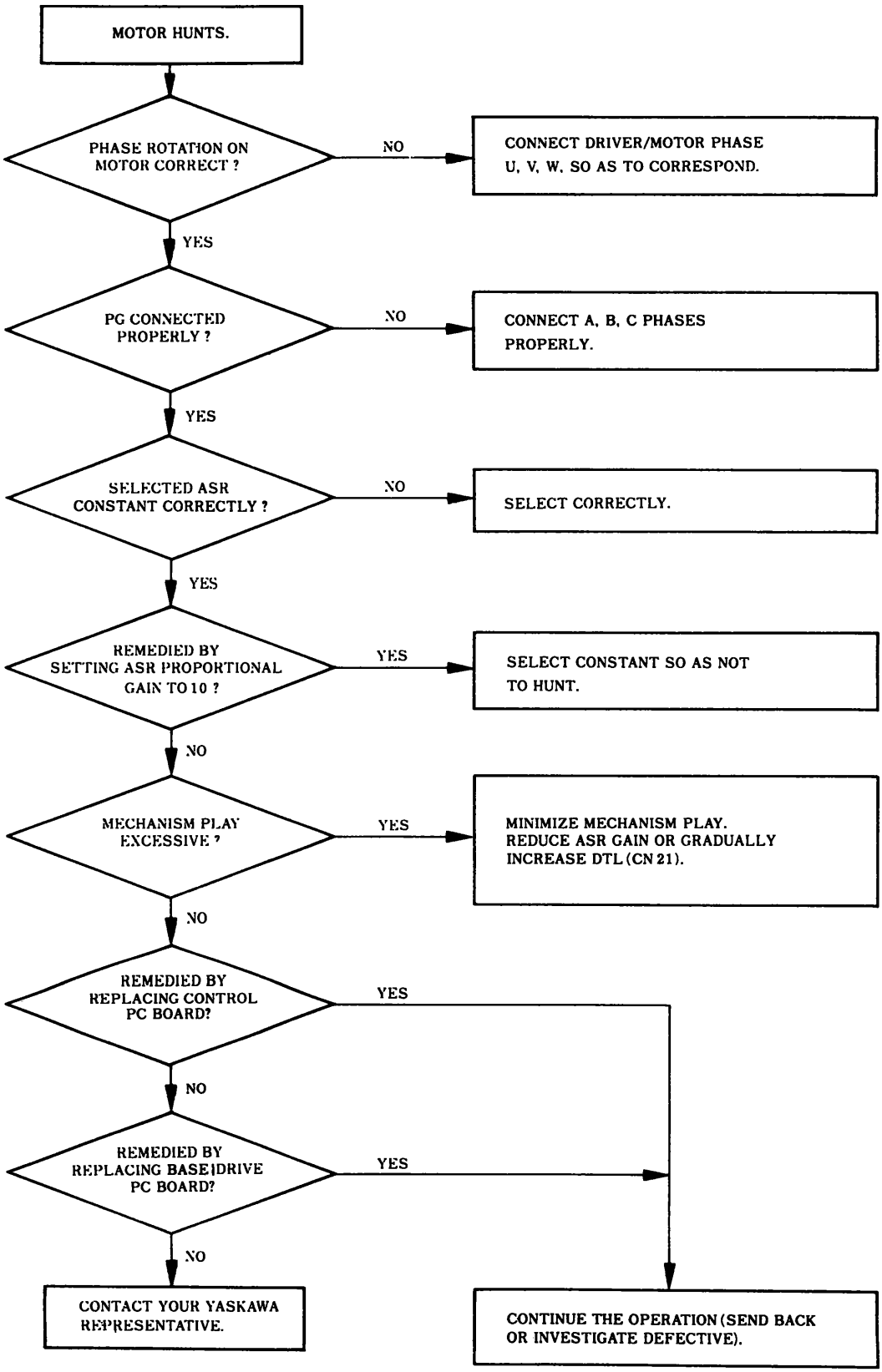
(3) Trouble display is stored even if power is turned off and can be checked by the error trace data shown on the monitor panel when power is turned on again. If power is turned off again, the memory data is erased.
Therefore, the error trace data must be recorded.

## 13.1 MOTOR MALFUNCTION

• Motor does not rotate.

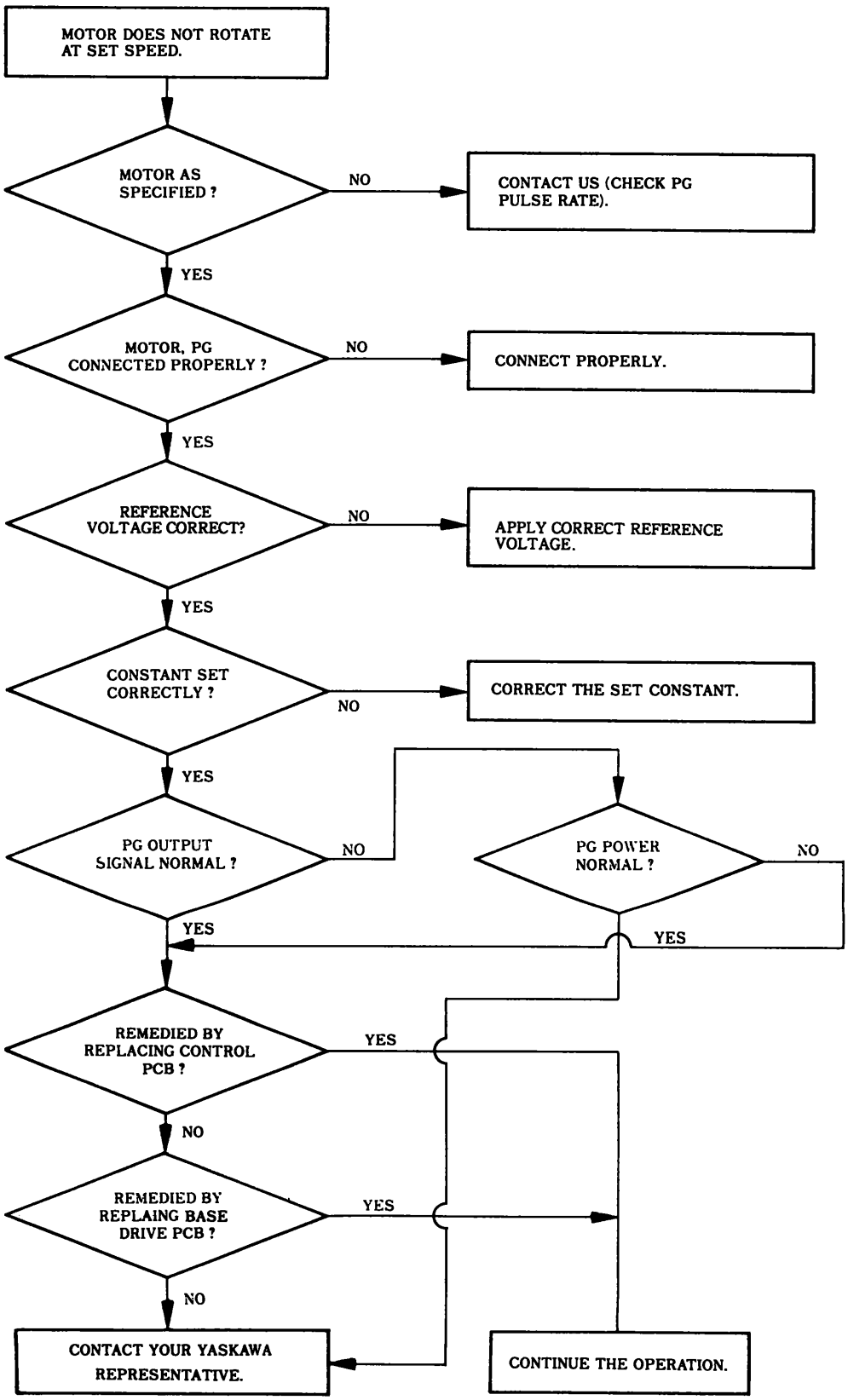


• Motor hunts.


MOTOR HUNTS.
PHASE ROTATION ON MOTOR CORRECT ?
NO
CONNECT DRIVER/MOTOR PHASE U, V, W, SO AS TO CORRESPOND.
YES
PG CONNECTED PROPERLY ?
NO
CONNECT A, B, C PHASES PROPERLY.
YES
SELECTED ASR CONSTANT CORRECTLY ?
NO
SELECT CORRECTLY.
YES
REMEDIED BY SETTING ASR PROPORTIONAL GAIN TO 10 ?
YES
SELECT CONSTANT SO AS NOT TO HUNT.
NO
MECHANISM PLAY EXCESSIVE ?
YES
MINIMIZE MECHANISM PLAY. REDUCE ASR GAIN OR GRADUALLY INCREASE DTL (CN 21).
NO
REMEDIED BY REPLACING CONTROL PC BOARD?
YES
NO
REMEDIED BY REPLACING BASE DRIVE PC BOARD?
YES
NO
CONTACT YOUR YASKAWA REPRESENTATIVE.
CONTINUE THE OPERATION (SEND BACK OR INVESTIGATE DEFECTIVE).

## 13.1 MOTOR MALFUNCTION (Cont'd)

· Motor does not rotate at a set speed.



## 13.2 ERROR INDICATION AND ERROR PROCESSING

Table 13.1 Error Indication and Error Processing

| Error Indication | Operation Level | Cause | Check | Corrective Action |
|---|---|---|---|---|
| OC<br>CLA<br>Over-current | OC<br>Operates when the servo driver output current (motor current) exceeds 4.5× [rated current of servo driver]<br>(Example<br>CIMR-SVJ-03AAA<br>Ioc=4.5×18=81(A)) | Wiring error | Check if the wiring between servo driver motors is correct according to the connection diagram. (Main circuit, PG line) | Correct the wiring. |
| | | Operation error | Check that the grounding of the servo driver and motor are connected correctly. | Ground the servo driver and motor using a cable of the specified size. |
| | | Short-circuit of load | • Measure the resistance between motor terminals to check that there are no short circuits.<br>• Check that there is no broken cable between the servo driver and motor. | If the motor is not operating properly, replace the motor.<br>If the cable is damaged, replace the cable. |
| | CLA<br>Operates at 4× [rated current of servo driver]<br>(Example<br>CIMR-SVJ-03AAA<br>ICLA =4 ×18=72(A)) | Grounding fault | Check that there is no grounding fault between the servo driver output and the grounding point. | Correct the grounding fault, if any. |
| | | Power transistor module error | Check the resistance between the terminals of the transistor module | Replace the transistor module. |
| | | Control card /base drive card error | Replace the card to see if it operates normally. | Replace the card. (Contact your YASKAWA representative.) |
| OU<br>UL<br>Over-voltage | OU<br>Operates when the voltage between main circuit P-N exceeds 420 V DC.<br>UL<br>Operates when the voltage between P-N becomes 395 V DC. | The power supply voltage is high. | Check the voltage between the input terminals.<br>• Voltage between the power supply unit input terminals (R, S, T) : 170 to 242 V AC<br>• Servo driver input voltage (between P-N) : 240 to 340 V DC. | Set the power supply voltage to conform to the specifications. (Change the tap of the power transformer, etc.) |
| | | Braking unit, brake resistor failure during deceleration. | • Check the wiring of the braking unit and brake resistor.<br>• Use a tester to check if the brake resistor is connected.<br>• Recheck the selection of the brake resistor (including the machine system $GD^2$). | Correct the failure. |
| OS<br>Overspeed | Operates when the motor speed reaches 120% the Cn01 preset value. | Poor adjustment | Check if the speed control unit constant ( Cn04 to Cn11 ) and the position loop gain ( Cn02 ) setting values are appropriate. | Readjust the value. |
| | | Excess regenerative load | Determine if there is excess regenerative load. (Regenerative torque of 200% or more.) | Reduce the regenerative load.<br>Expand the servo driver and servo motor capacity. |

Table 13.1 Error Indication and Error Processing (Cont'd)

| Error Indication | Operation Level | Cause | Check | Corrective Action |
|---|---|---|---|---|
| CUU<br>Control power supply low voltage | CUU<br>Operates when $P_0$-$N_0$ falls below 170V DC. | The input voltage is low. | Check the voltage between the input terminals.<br>Between main circuit P-N<br>Between control circuit $P_0$-$N_0$<br>Normal level : 170V to 242V | Raise the input voltage so that it conforms to the specifications. |
| PUU<br>Main power supply low voltage | PUU<br>Operates when P-N falls below 220V DC. | Power failure, open phase of the input voltage | Check the voltage between the input terminals of the power supply unit. | Adjust the voltage to the normal voltage. |
| | | Control card /base drive card failure | Replace the card to see if it operates normally. | Replace the card. (Contact your YASKAWA representative) |
| OL 1<br>Servo driver overload | OL operation time<br>Current / Operation time<br>100% / ∞<br>150% / 50 seconds<br>200% / 10 seconds | Overload | Check if the servo driver is not operating when exceeding the OL operation time. | Lighten the load. |
| | | Wiring failure (wiring error, wire disconnection) | Check if the wiring between the servo driver motor is as shown in the connection diagram. (Main circuit, PG line) | Correct the wiring. |
| OH 1<br>Servo driver overheat | Operates when the heat sink is overheated.<br>Note: Operated temperature differs depending on the motor outputs. (65℃ to 90℃) | Overload | Check if the servo driver is not operating when exceeding the OL operation time. | Lighten the load. |
| | | The ambient temparature of the servo driver is high. | Check that the ambient temparature of the servo driver is less than 55℃. | Cool the servo driver so that the ambient temperature is under 55℃. |
| | | Deterioration of the cooling function | Check if the servo driver cooling fan has stopped, or if excessive oil and dust has adhered to the cooling fan. | Correct the error. |
| OH2<br>Low frequency | Operates when the low frequency (less than 3Hz) is overloaded. | Overload at low-frequency of inverter output curre nt | Check the load if the inverter output current is under 3Hz frequency. | Lighten the load at low-speed. |
| OLM<br>Motor overload | OLM<br>Operates when the motor temperature exceeds 140℃. | Motor overload | If the motor temperature is actually rising, check the load torque. | Lighten the load. |
| | | Motor cooling error | Check if the servo driver cooling fan has stopped, or if dust is blocking the ventilation path. | Correct the error. |

Table 13.1 Error Indication and Error Processing (Cont'd)

| Error Indication | Operation Level | Cause | Check | Corrective Action |
|---|---|---|---|---|
| OHn<br>Motor overheat | OHn<br>Operates when the motor temperature exceeds 155℃. | Short circuit of thermosensor signal line | Check with a tester. | Correct the error. |
| FU<br>Fuse blow | Operates when the servo driver fuse is blown. | Same as overcurrent (OC). | Check if the fuse is broken. Refer to the descriptions of overcurrent (OC). Check the power transistor. | Replace the fuse. Always check the power transistor, and replace the transistor, if abnormal. |
| PG<br>PG signal error | Operates if the PG pulse is not fed back for 5 seconds after the speed reference is input under an operation ready state. | PG cable disconnection | Check the wiring and conductivity of the PG cable | Correct the error. |
| | | Main circuit disconnection | Check the connection between servo driver motors (U, V, W). | Correct the error. |
| | | The servo motor shaft is mechanically bound. | Check the area surrounding the machine. Check that no error occurs by separating the shaft from the machine. Check that the brake is freed. | Correct the error. |
| | Operates when the absolute encoder is used even if a fault exists with serial data received. | Absolute encoder and peripheral errors | Check the absolute encoder and peripherals. | Replace the board or the encoder. (Contact your YASKAWA representative.) |
| APG<br>Absolute encoder error | Initial serial data error if it occurs immediately after inputting the SEN signal.<br><br>Encoder pulse number error if it occurs during motor running. | PG cable error | Check the wiring and conductivity of the PG cable | Correct the failure. |
| | | Mulfunction by noise | Check the gronding | Check that the grounding line is connected correctly. |
| | | Data backup error at initial serial data occurrence | Check the battery voltage is under 3V. | Replace the battery. |
| | | | Check that more than 4 days have passed since the battery is disconnected. | Perform the set-up of the absolute encoder |
| | | Control card error | Shut down the power. After monitor panel display is off, turn on the power again. | Replace the control card. (Contact your YASKAWA representative) |
| | | Absolute encoder error | | Replace the absolute encoder. (Contact your YASKAWA representative) |

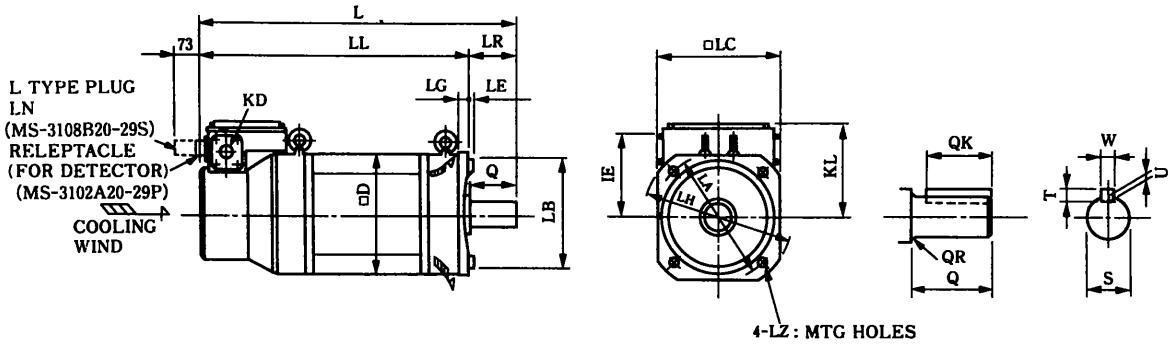
## 13.2 ERROR INDICATION AND ERROR PROCESSING (Cont'd)

Table 13.1 Error Indication and Error Processing (Cont'd)

| Error Indication | Operation Level | Cause | Check | Corrective Action |
|---|---|---|---|---|
| nC<br>MC on error | Operates when the electro-magnetic contactor that controls the servo driver internal rush current dose not close. | The input voltage of the main circuit is low. | Check the input voltage between P-N : 170 to 242 V | Raise the voltage so that it is within the input voltage specifications. |
| | | Servo driver error | Check that the MC is on. | Replace the servo driver. (Contact your YASKAWA representative) |
| OHL<br>Abnormally low motor temperature | Operates when the temperature of the motor falls below −14℃. | Broken thermister | Check the thermister signal line with a tester. | Repair the signal line. |
| | | The temperature of the motor is too low. | Check the ambient temperature of the motor.<br>Specification : 0 to 40℃ | Increase the surrounding area so that the ambient temperarure of the motor meets the specified temperature. |
| AOn,nU2<br>nU1,AnO<br>An1,PGC<br>Ad,AdC<br>Control error | Operates when serious error is detected by self diagnosis. | Control card error | Turn off the power supply once, and then turn it on again after the indication on the monitor panel goes out. | If the error is displayed again, replace the controller. (Contact your YASKAWA representative.) |
| | | Control circuit operation error | | Check that the grounding line is connected correctly. |
| OP<br>Option error | Operates when error occurs in the signal exchange between the option card and the control card. | Option card mount error | Check the connection at the connector of the option card. | Connect firmly. |
| | | Option card error | Replace the option card once to check if it operates properly. | Replace the option card. (Contact your YASKAWA representative.) |
| LF<br>Load failure | Operates when cable disconnection is detected between the servo driver and servo motor. | Open phase/ line disconnection of load | Check the wiring. | Repair the error. |

## 14. DIMENSIONS in mm (inch)

### (1) Servomotor (Flange-mounted)




| Servomotor | | L | LA | LB | LC | LE | LG | LH | LL | LR | LZ | D | IE | KD | KL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1500rpm Series | 750rpm Series | | | | | | | | | | | | | | |
| UAACKA-03A□2K | — | 467 (18.4) | 200 (7.87) | 114.3 $^{0}_{-0.025}$ (4.5 $^{0}_{-0.00098}$) | 180 (7.09) | 3.2 (0.126) | 18 (0.908) | 230 (9.06) | 387 (15.2) | 80 (3.15) | 13.5 (0.531) | 174 (6.85) | 128 (5.04) | 34 (1.34) | 141 (5.55) |
| UAACKA-04A□2K | — | 505 (19.9) | | | | | | | 425 (16.7) | | | | | | |
| UAACKA-06A□2K | UAACKL-03A□2K | 545 (21.5) | | | | | | | 465 (18.3) | | | | | | |
| UAACKA-08A□2K | UAACKL-04A□2K | 570 (22.4) | 215 (8.46) | 180 $^{0}_{-0.040}$ (7.09 $^{0}_{-0.00158}$) | 204 (8.03) | 5 (0.197) | 20 (0.789) | 250 (9.84) | 460 (18.1) | 110 (4.33) | 14 (0.551) | 204 (8.03) | 144 (5.67) | 42.5 (1.67) | 159 (6.26) |
| UAACKA-11A□2K | UAACKL-06A□2K | 625 (24.6) | | | | | | | 515 (20.3) | | | | | | |
| UAACKA-15A□2K | UAACKL-08A□2K | 700 (27.6) | | | | | | | 590 (23.2) | | | | | | |
| UAACKA-22A□2K | UAACKL-11A□2K | 650 (25.6) | 300 (11.8) | 250 $^{0}_{-0.040}$ (9.84 $^{0}_{-0.00190}$) | 280 (11.0) | | 22 (0.866) | 350 (13.8) | 540 (21.3) | | 18 (0.709) | 260 (10.2) | 172 (6.77) | | 183 (7.20) |
| UAACLA-30A□2K | UAACLL-15A□2K | 695 (27.4) | | | | | | | 585 (23.0) | | | | | | |
| UAACKA-37A□2K | UAACLL-19A□2K | 755 (29.7) | | | | | | | 645 (25.4) | | | | | | |

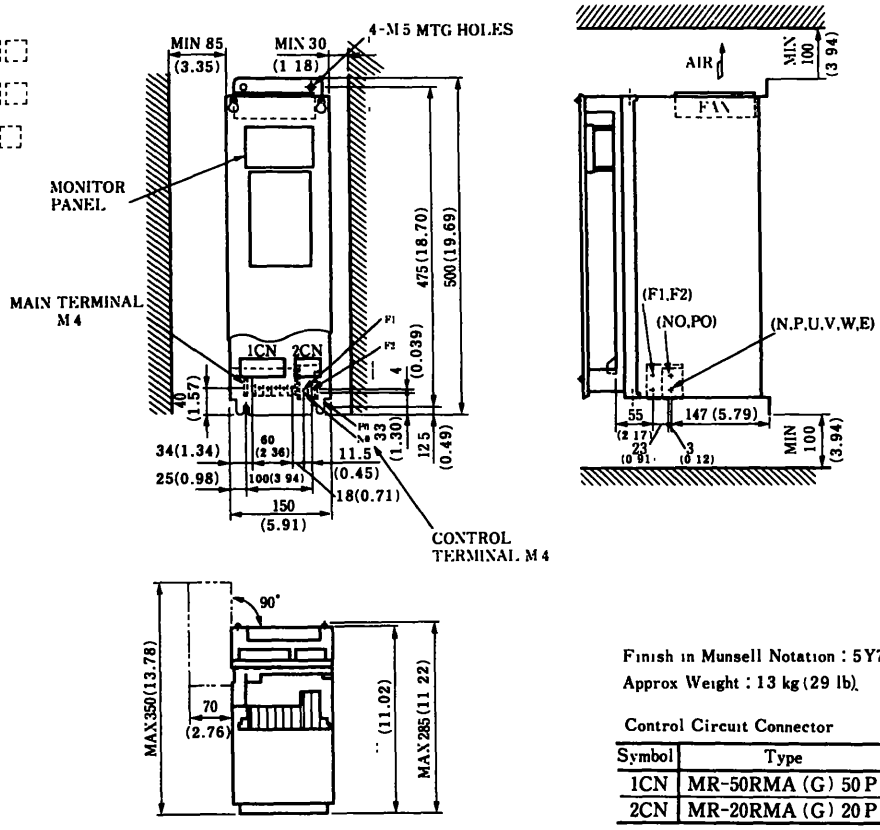
| Servomotor | | Shaft End | | | | | | | Approx Weight kg(lb) |
|---|---|---|---|---|---|---|---|---|---|
| 1500rpm Series | 750rpm Series | Q | QK | QR | S | T | V | W | |
| UAACKA-03A□2K | — | 80 (3.15) | 60 (2.36) | 0.5 (0.0197) | 38 $^{+0.018}_{+0.002}$ (1.50 $^{+0.00071}_{+0.00008}$) | 8 (0.315) | 5 (0.197) | 10 (0.394) | 35 (77) |
| UAACKA-04A□2K | — | | | | | | | | 45 (99) |
| UAACKA-06A□2K | UAACKL-03A□2K | | | | | | | | 55 (121) |
| UAACKA-08A□2K | UAACKL-04A□2K | 110 (4.33) | 90 (3.54) | 1 (0.0394) | 42 $^{+0.018}_{+0.002}$ (1.65 $^{+0.00071}_{+0.00008}$) | | | 12 (0.472) | 50 (110) |
| UAACKA-11A□2K | UAACKL-06A□2K | | | | | | | | 65 (143) |
| UAACKA-15A□2K | UAACKL-08A□2K | | | | | | | | 70 (154) |
| UAACKA-22A□2K | UAACKL-11A□2K | | | 2 (0.0787) | 55 $^{+0.030}_{+0.11}$ (2.17 $^{+0.00118}_{+0.00043}$) | 10 (0.394) | 6 (0.236) | 16 (0.630) | 115 (254) |
| UAACLA-30A□2K | UAACLL-15A□2K | | | | | | | | 135 (298) |
| UAACKA-37A□2K | UAACLL-19A□2K | | | | | | | | 165 (364) |

Note : L-type plug and cable clamp for connecting receptacte are not provided.

## 14. DIMENSIONS in mm (inch)(Cont'd)

### (2) Servo Drivers

- CIMR-SVJ-03AA□□□
- CIMR-SVJ-04AA□□□
- CIMR-SVJ-03LA□□□

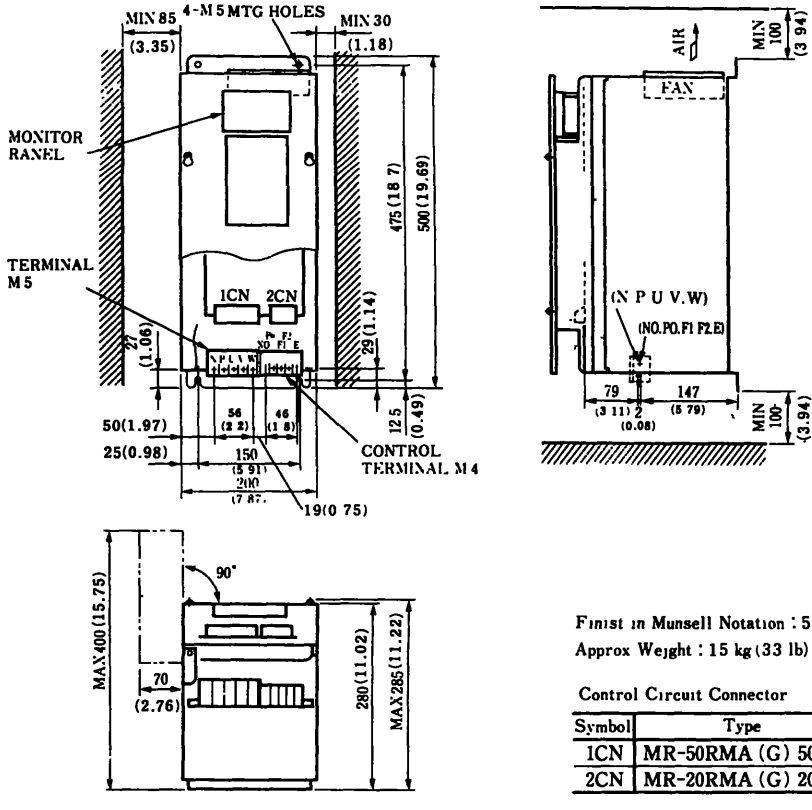



Finish in Munsell Notation : 5Y7/1
Approx Weight : 13 kg (29 lb)

Control Circuit Connector

| Symbol | Type |
|---|---|
| 1CN | MR-50RMA (G) 50P |
| 2CN | MR-20RMA (G) 20P |

- CIMR-SVJ-06AA□□□
- CIMR-SVJ-04LA□□□

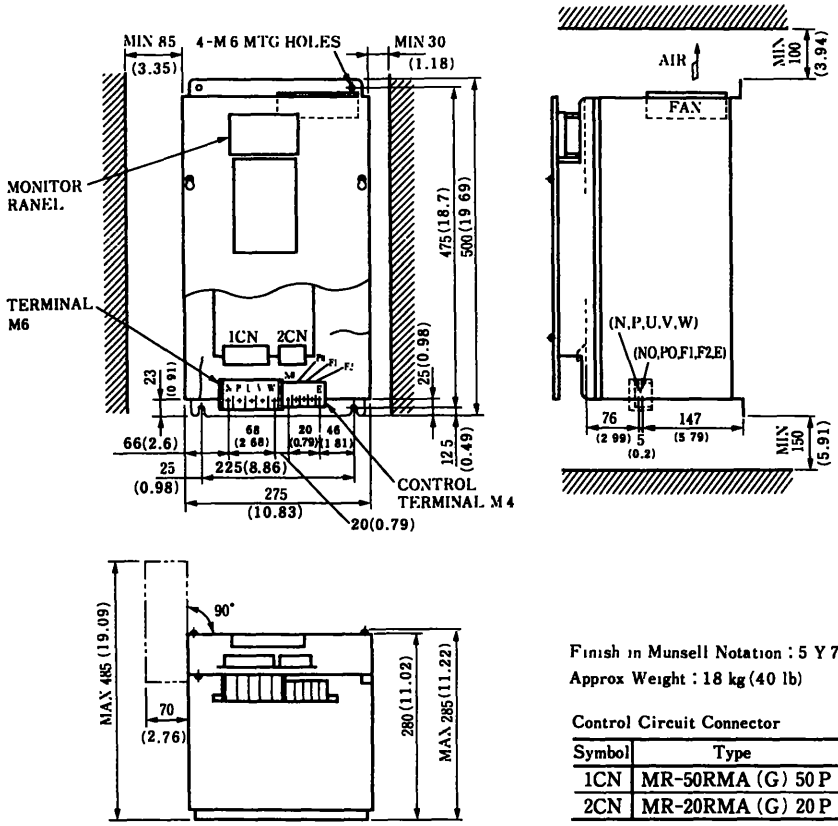



Finist in Munsell Notation : 5 Y 7/1
Approx Weight : 15 kg (33 lb)

Control Circuit Connector

| Symbol | Type |
|---|---|
| 1CN | MR-50RMA (G) 50P |
| 2CN | MR-20RMA (G) 20P |

- CIMR-SVJ-08AA□□□
- CIMR-SVJ-06LA□□□
- CIMR-SVJ-08LA□□□

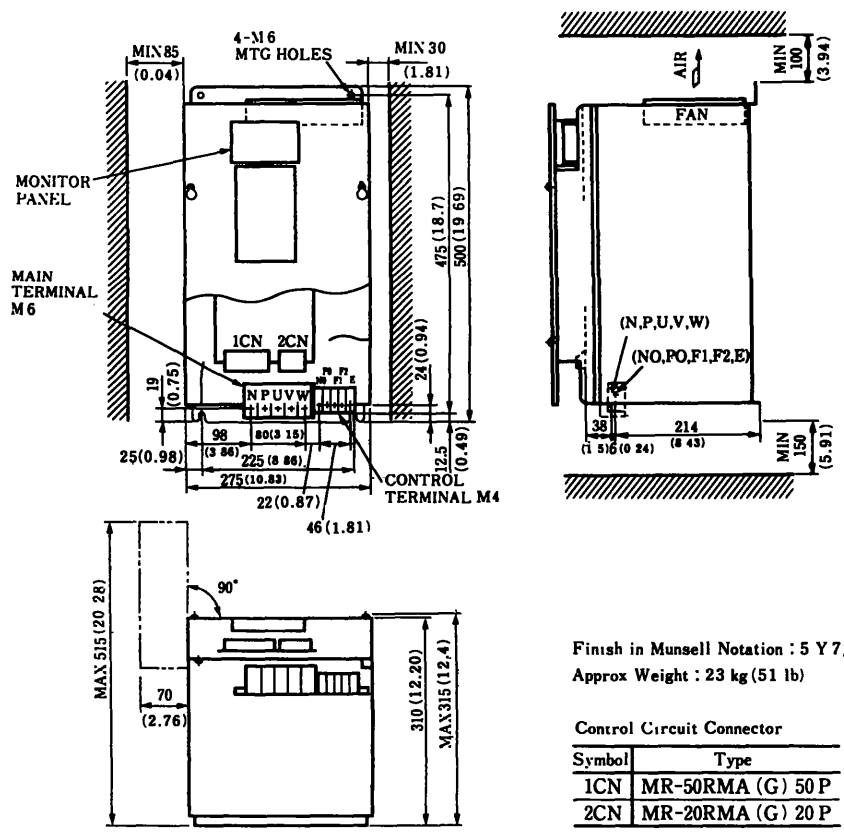



Finish in Munsell Notation : 5 Y 7/1
Approx Weight : 18 kg (40 lb)

Control Circuit Connector

| Symbol | Type |
|---|---|
| 1CN | MR-50RMA (G) 50 P |
| 2CN | MR-20RMA (G) 20 P |

- CIMR-SVJ-11AA□□□
- CIMR-SVJ-11LA□□□



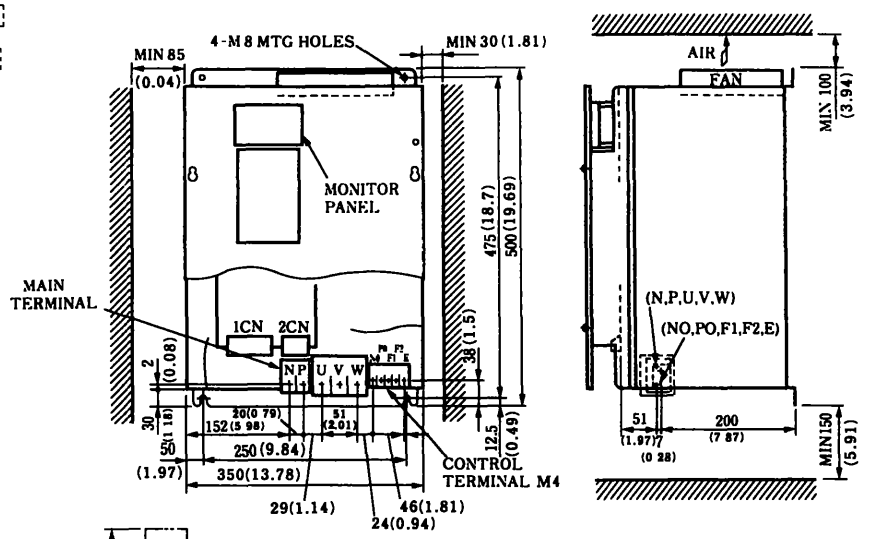

Finish in Munsell Notation : 5 Y 7/1
Approx Weight : 23 kg (51 lb)

Control Circuit Connector

| Symbol | Type |
|---|---|
| 1CN | MR-50RMA (G) 50 P |
| 2CN | MR-20RMA (G) 20 P |

## 14. DIMENSIONS in mm (inch)(Cont'd)

- CIMR-SVJ-15AA□□□
- CIMR-SVJ-15LA□□□

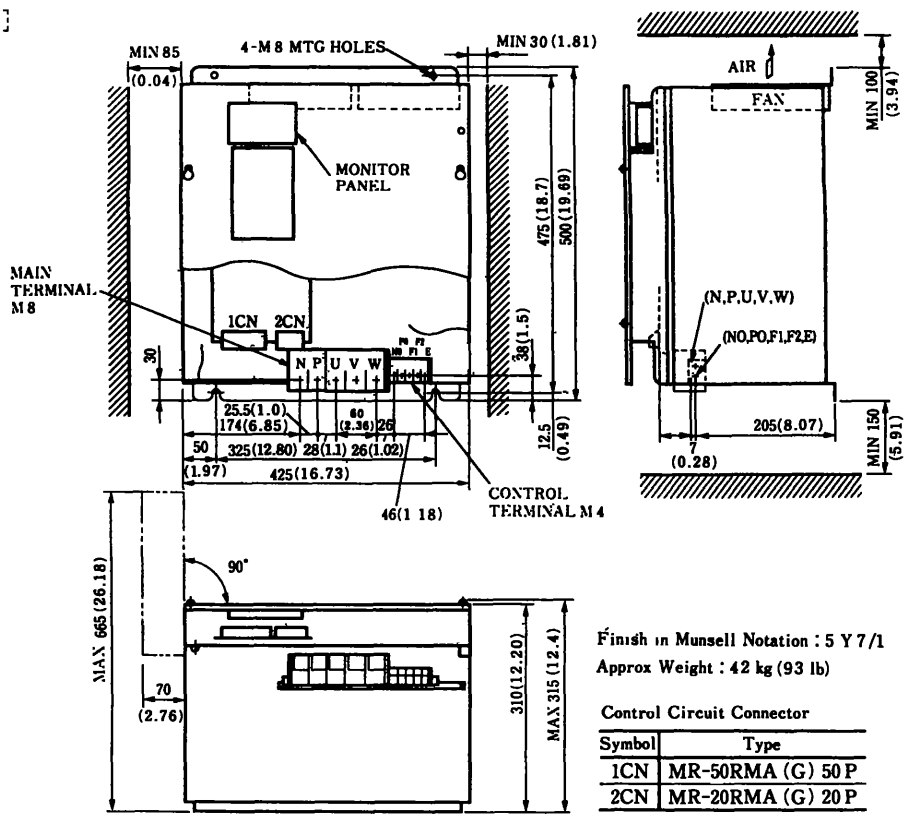



Finish in Munsell Notation : 5 Y 7/1
Approx Weight : 30 kg (66 lb)

Control Circuit Connector

| Symbol | Type |
|---|---|
| 1CN | MR-50RMA (G) 50 P |
| 2CN | MR-20RMA (G) 20 P |

- CIMR-SVJ-22AA□□□
- CIMR-SVJ-19LA□□□

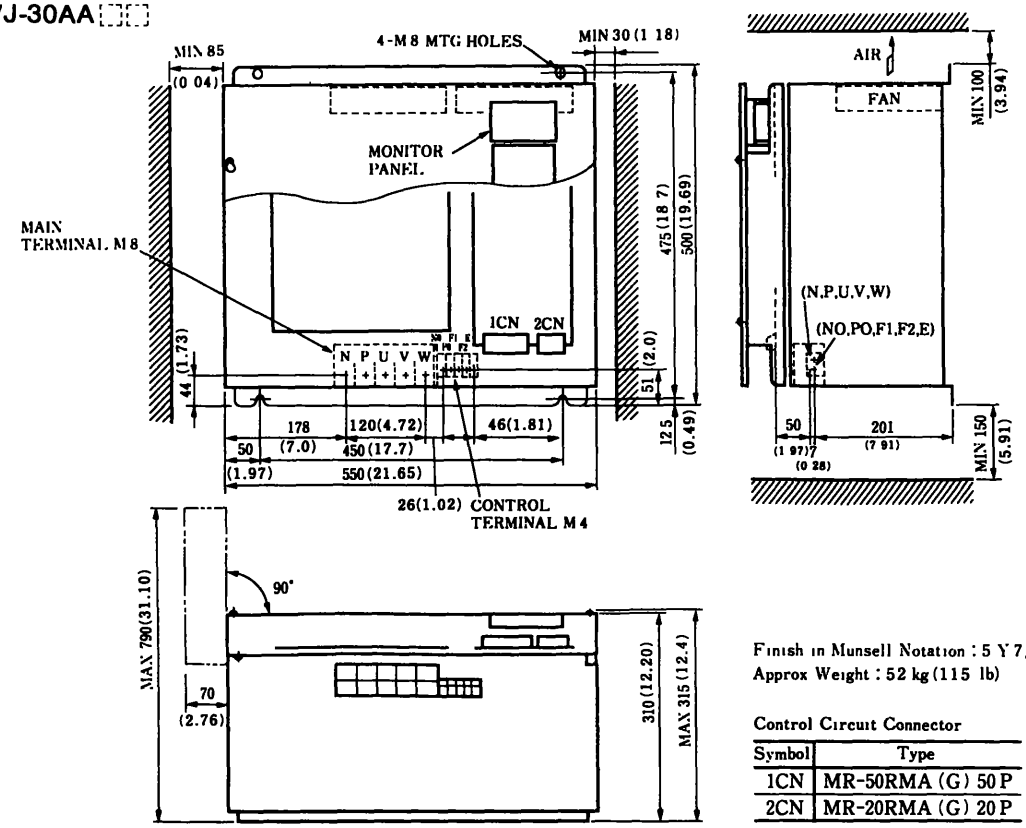



Finish in Munsell Notation : 5 Y 7/1
Approx Weight : 42 kg (93 lb)

Control Circuit Connector

| Symbol | Type |
|---|---|
| 1CN | MR-50RMA (G) 50 P |
| 2CN | MR-20RMA (G) 20 P |

• CIMR-SVJ-30AA□□

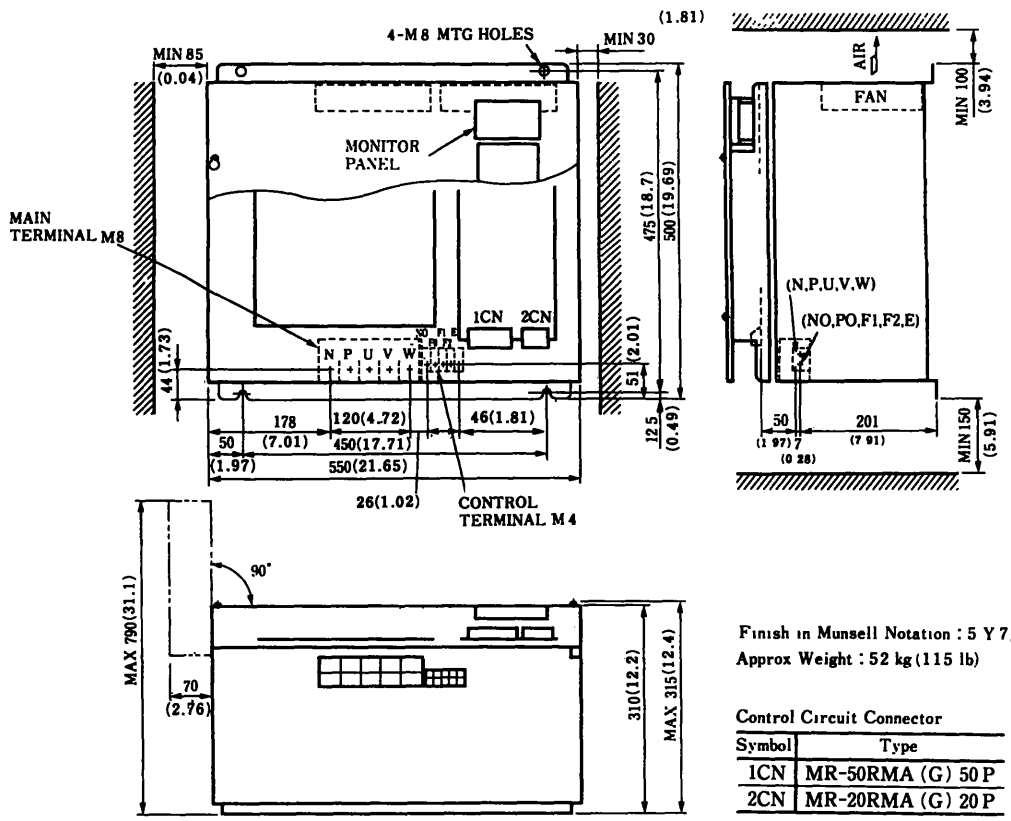



Finish in Munsell Notation : 5 Y 7/1
Approx Weight : 52 kg (115 lb)

Control Circuit Connector

| Symbol | Type |
|---|---|
| 1CN | MR-50RMA (G) 50 P |
| 2CN | MR-20RMA (G) 20 P |

• CIMR-SVJ-37AA□□




Finish in Munsell Notation : 5 Y 7/1
Approx Weight : 52 kg (115 lb)

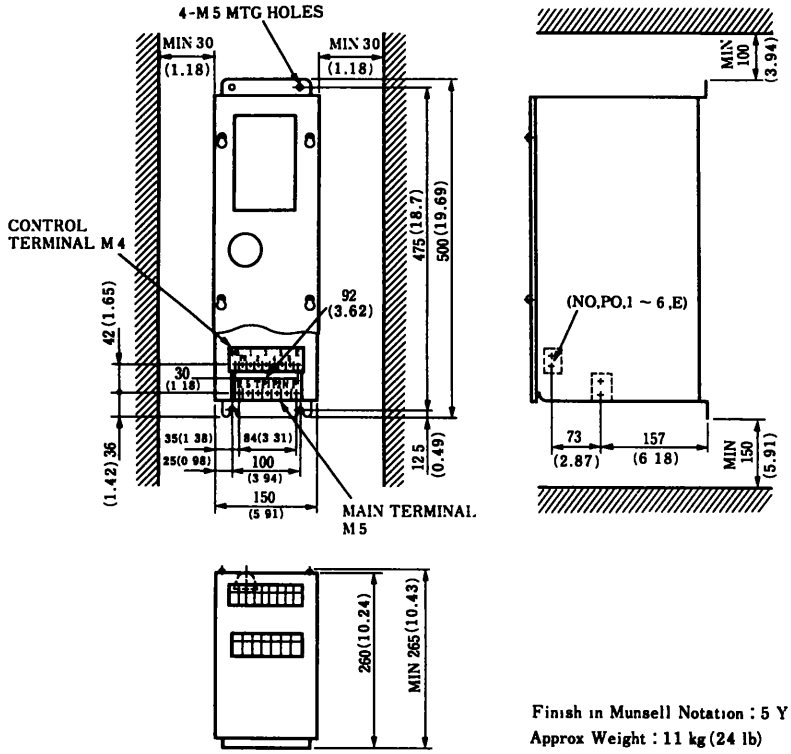
Control Circuit Connector

| Symbol | Type |
|---|---|
| 1CN | MR-50RMA (G) 50 P |
| 2CN | MR-20RMA (G) 20 P |

## 14. DIMENSIONS in mm (inch)(Cont'd)

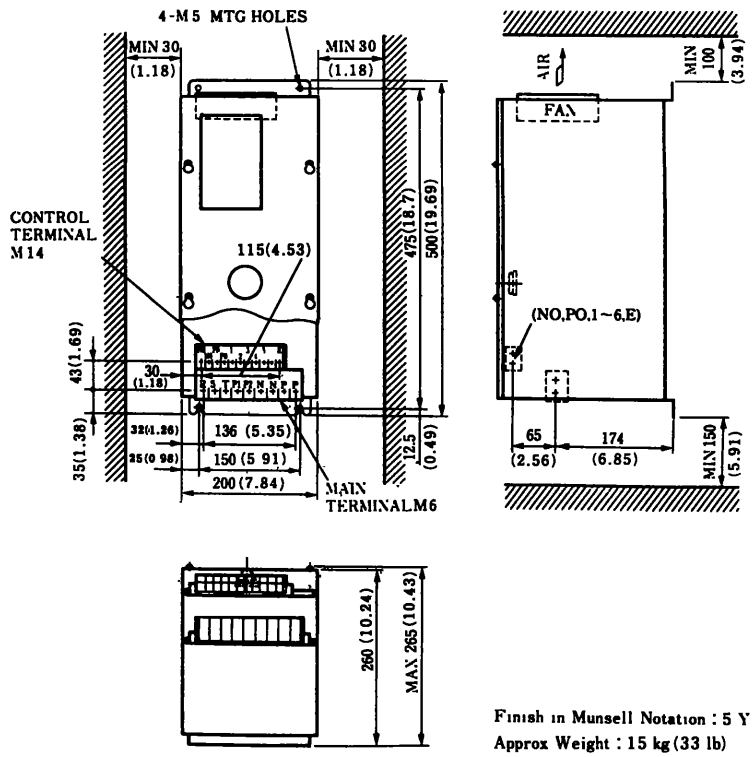
### (3) Power units

• NPSN-0303L



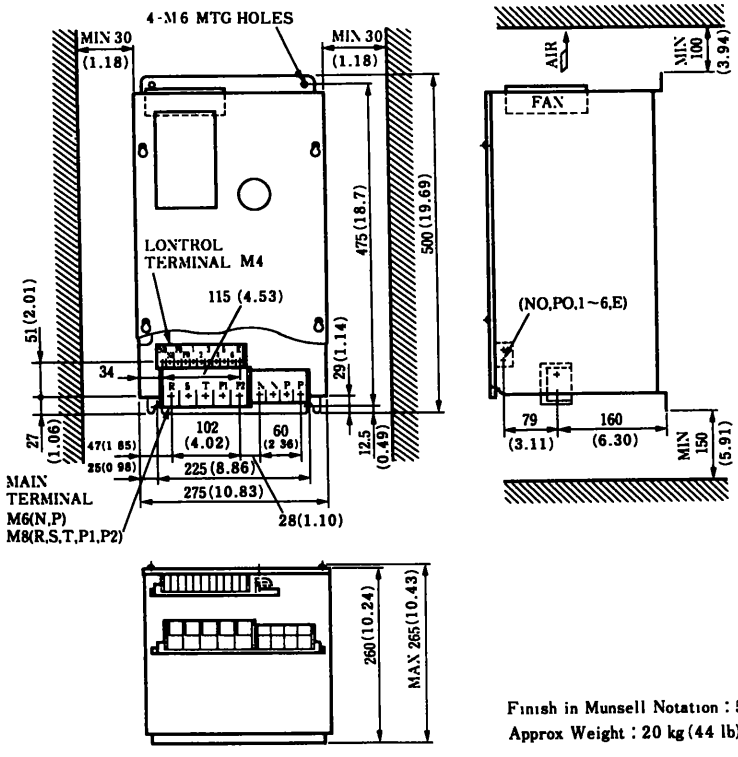

Finish in Munsell Notation : 5 Y 7/1
Approx Weight : 11 kg (24 lb)

• NPSO-0503L



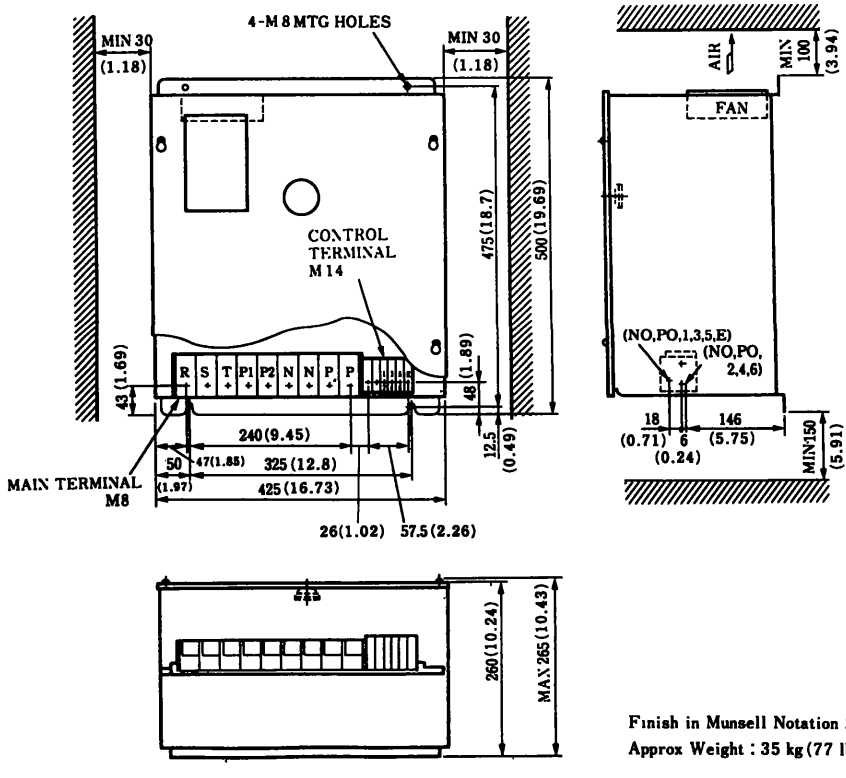

Finish in Munsell Notation : 5 Y 7/1
Approx Weight : 15 kg (33 lb)

• NPSO-0803L




Finish in Munsell Notation : 5 Y 7/1
Approx Weight : 20 kg (44 lb)

• NPSO-1303L

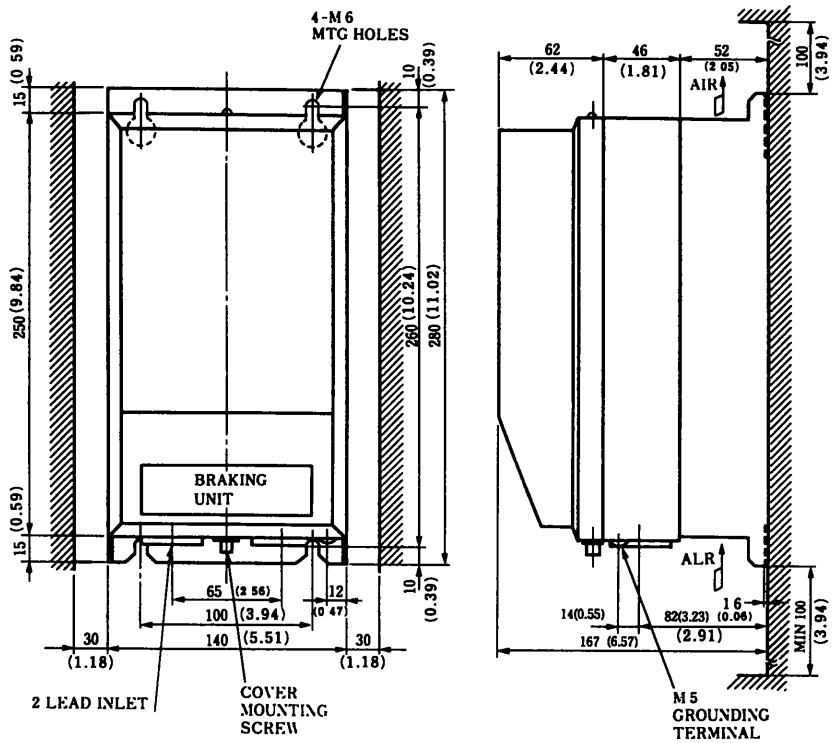



Finish in Munsell Notation : 5 Y 7/1
Approx Weight : 35 kg (77 lb)

## 14. DIMENSIONS in mm (inch)(Cont'd)

### (4) Damping Unit

• CDBR-2022

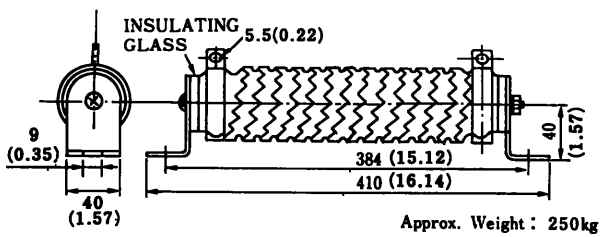



Finish in Munsell Notation : Cover–5 PB 3/9
Case–5 Y 7/1

Approx Weight : 4 kg (9 lb)

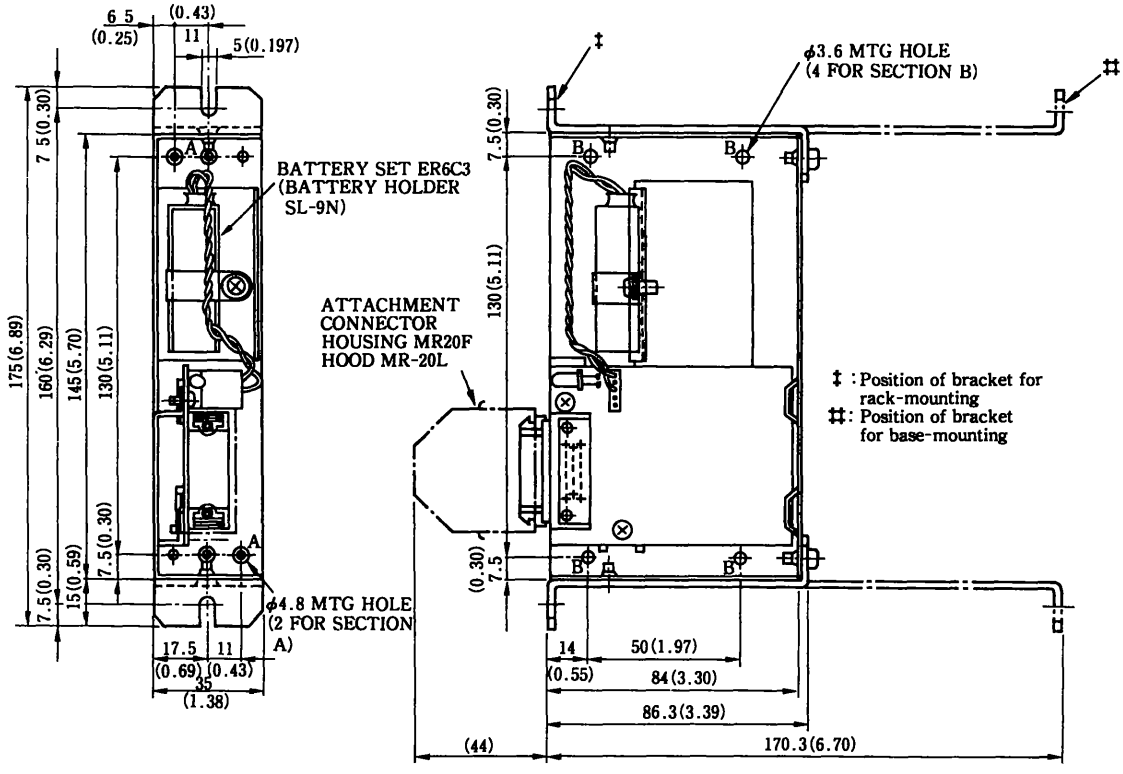
### (5) Braking Resistor

• GRZG 600 W 30 Ω (R 007195)




Approx. Weight : 250kg (551 lb)

(6) Battery Module

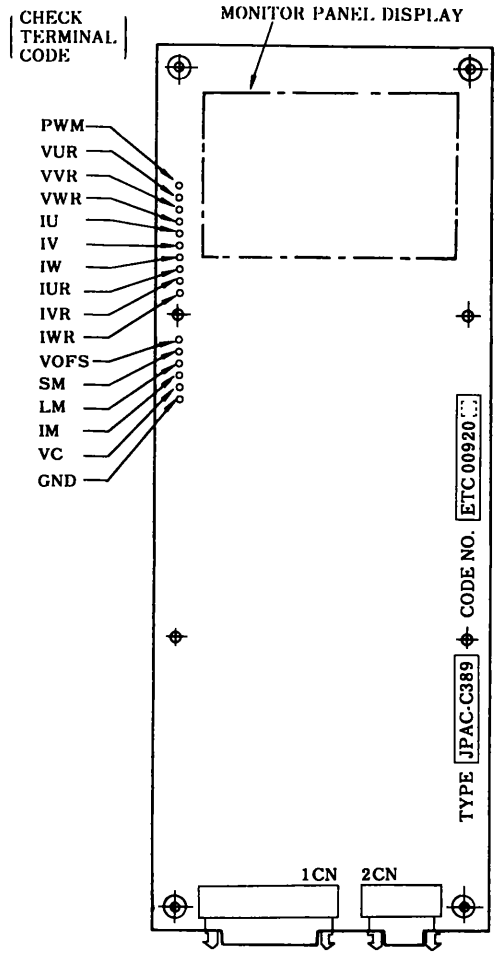



## 15 PERIPHERAL UNITS

| Applicable Inverter | | Rated Capacity KVA | Raetd Current A | Molded Case Circuit Braker (MCCB) (Model and Rated)*1 | Magnetic Contactor (Model)*2 | AC Reactor Model UZBA-B (Model and Rated)*3 |
|---|---|---|---|---|---|---|
| 1500r/min Series CiMR-SVJ- | 750r/min Series CiMR-SVJ- | | | | | |
| 03A □□ | 03L □□ | 6 | 18 | NF50-CS, AC50A, 3P | HI-20ETU | X002492, 30A, 0.35mH |
| 04A □□ | – | 9 | 27 | NF100-CS, AC75A, 3P | HI-30ETU | X002493, 40A, 0.265mH |
| 06A □□ | 04L □□ | 13 | 40 | NF100-CS, AC100A, 3P | HI-35ETU | X002498, 90A, 0.12mH |
| 08A □□ | 06L □□ | 18 | 55 | NF255-CS, AC125A, 3P | HI65E2TU | X002555, 120A, 0.09mH |
| | 08L □□ | | | | | |
| 11A □□ | 11L □□ | 25 | 80 | NF225-CS, AC175A, 3P | HI-100E2TU | X002556, 160A, 0.07mH |
| 15A □□ | 15L □□ | 35 | 110 | NF225-CS, AC225A, 3P | HI-125E2TU | X002557, 200A, 0.05mH |
| 22A □□ | 19L □□ | 45 | 135 | NF400-CS, AC300A, 3P | HI-200E2TU | X002559, 280A, 0.039mH |
| 30A □□ | – | 60 | 190 | NF400-CS, AC300A, 3P | HI-20E2TU | X002559, 280A, 0.039mH |
| 37A □□ | – | 80 | 240 | NF400-CS, AC400A, 3P | HI-300E | X002560, 360A, 0.026mH |

*1 Manufactured by MITUBISHI ELECTRIC CORP.
*2 Manufactured by YASKAWA CONTROL CO., LTD.
*3 Manufactured by YASKAWA ELECTRIC CORPORATION

## APPENDIX CHECK TERMINAL




Note: Check terminal codes shown on the PC board.

| Code | Name | Description |
|---|---|---|
| PWM | PWM carrier signal | Carrier signal (3kHz) of main circuit transistor switching. |
| VUR<br>VVR<br>VWR | U-phase<br>V-phase<br>W-phase } Voltage reference | Voltage reference for each phase (Current amplifier output, forward running) Amplitude and frequency differ according the speed. |
| IU<br>IV<br>IW | U-phase<br>V-phase<br>W-phase } current | Current for each phase (Forward running) |
| IUR<br>IVR<br>IWR | U-phase<br>V-phase<br>W-phase } current reference | Current reference for each phase (Forward running) |
| VOFS | Voltage reference synthetic signal | Check signal within industrial |
| SM | Speed monitor | motor speed monitor singal<br>• ± 6V / N100<br>• Setting value (r/min) for N100: Cn01<br>• + at forward running,<br>− at reverse running |
| LM | Torque monitor | Motor torque monitor signal<br>• ± 3V / ± motor rated torque<br>• + at forward running,<br>− at reverse running |
| IM | Current monitor | Motor current monitor signal<br>• + 5V / servo driver rated current |
| VC | Internal power supply | + 5V |
| GND | Signal ground | 0V |

Note:
1. Do not moinitor check terminals during operation. (Only SM, LM and IM can be monitored during operation.)
2. The standard for each check terminal is GND.
3. In monitoring, be sure not to short-circuit between check terminals. The internal element may be destroyed by short circuiting.
4. Be sure to set the load resistance value between check terminal and GND at 10kΩ or more.
5. Normally, do not connect anything to check terminals.
6. The signals of SM, LM and IM are the same as speed monitor, torque monitor, and current monitor since they are being output from 1CN.

NOTES

MEMO

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**SEOUL OFFICE** 8th Floor Seoul Center Bldg, 91-1, Sogong-Dong, Chung-ku, Seoul, Korea 100-070
Phone (02) 776-7844 Fax (02) 753-2639
**TAIPEI OFFICE** Shen Hsiang Tang Sung Chiang Building 10F 146 Sung Chiang Road, Taipei, Taiwan
Phone (02) 563-0010, -7732 Fax (02) 567-4677
**YASKAWA ELECTRIC AMERICA, INC.**
**Chicago-Corporate Headquarters** 2942 MacArthur Blvd Northbrook, IL 60062-2028, U S.A
Phone (708) 291-2340 Fax (708) 498-2430
**Chicago-Technical Center** 3160 MacArthur Blvd Northbrook, IL 60062-1917, U S A
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Box 130 S-38500 Torsas, Sweden
Phone 0486-10575 Fax 0486-11410
**Motoman Robotec GmbH**
Kammerfeldstraße 1, 8051 Allershausen, Germany
Phone 08166-900 Fax 08166-9039
**YASKAWA ELECTRIC UK LTD.**
3 Drum Mains Park Orchardton Woods Cumbernauld, Scotland, G68 9LD U K
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**YASKAWA ELETRICO DO BRASIL COMERCIO LTDA.**
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Phone (011) 35-1911 Fax (011) 37-7375
**YASKAWA ELECTRIC (SINGAPORE) PTE. LTD.**
**Head Office** : CPF Bldg, 79 Robinson Road # 13-05, Singapore 0106, SINGAPORE
Phone 221-7530 Telex (87) 24890 YASKAWA RS Fax 224-5854
**Service Center** : 221 Henderson Road, # 07-20 Henderson Building Singapore 0315, SINGAPORE
Phone 276-7407 Fax 276-7406
**YATEC ENGINEERING CORPORATION**
Shen Hsiang Tang Sung Chiang Building 10F 146 Sung Chiang Road, Taipei, Taiwan
Phone (02) 563-0010 Fax (02) 567-4677


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